ENERGY AND RURAL DEVELOPMENT: WHAT IS NEEDED, WHAT IS BEING DONE

HEARING

BEFORE THE

SUBCOMMITTEE ON
ENERGY DEVELOPMENT AND APPLICATIONS

OF THE

COMMITTEE ON
SCIENCE AND TECHNOLOGY
U.S. HOUSE OF REPRESENTATIVES

NINETY-EIGHTH CONGRESS

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CONTENTS

WITNESSES

	Page
April 15, 1983:	
Hon. Wayne Mixson, Lieutenant Governor of the State of Florida	12
Thomas Thayer, Governor's Energy Office; Victoria Tschinkel, secretary of the Department of Environmental Regulation; and Dr. Charles Kidd, dean of the College of Engineering, Science and Technology and Agriculture at Florida A&M University	35
Wayne Smith, director of the Center for Biomass Energy Systems of the University of Florida, Institute of Food and Agriculture Sciences; Dr. Robert San Martin, deputy assistant secretary of energy for renewable energy; John Shields, director of agriculture and development of the Tennessee Valley Authority	95
Appendix: Additional statements submitted for the record	165

ENERGY AND RURAL DEVELOPMENT: WHAT IS NEEDED, WHAT IS BEING DONE

FRIDAY, APRIL 15, 1983

HOUSE OF REPRESENTATIVES,
COMMITTEE ON SCIENCE AND TECHNOLOGY,
SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS,
Washington, D.C.

The subcommittee met, pursuant to call, at 9 a.m., at the college auditorium, Chipola Junior College, Marianna, Fla., Don Fuqua (chairman of the subcommittee) presiding.

Present: Representatives Fuqua, Nelson, Sensenbrenner, and Lewis.

Staff Present: Dr. Jesse Poore, executive director, Committee on Science and Technology; Dr. Martha Krebs, staff director; Dave Bouchard, congressional fellow, Subcommittee on Energy Development and Applications.

Also Present: John Ratzel, Republican council; Lieutenant Governor Mixson, State of Florida.

[The opening statement of Mr. Fuqua follows:]

OPENING STATEMENT
OF THE

HONORABLE DON FUQUA (D-FLA.)

SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
FIELD HEARING ON
RURAL ECONOMIC DEVELOPMENT AND ENERGY

APRIL 15, 1983
MARIANNA, FLORIDA

IT GIVES ME GREAT PLEASURE TO WELCOME MY COLLEAGUES FROM THE ENERGY DEVELOPMENT AND APPLICATIONS SUBCOMMITTEE TO MARIANNA AND CHIPOLA JUNIOR COLLEGE. I HOPE YOUR STAY HERE WILL BE BOTH ENJOYABLE AND ENLIGHTENING.

I AM ALSO PLEASED TO WELCOME OUR DISTINGUISHED WITNESSES, MANY OF WHOM ARE FRIENDS, TO TESTIFY BEFORE US ABOUT THE NEEDS OF RURAL AREAS SUCH AS THIS PART OF FLORIDA, AND THE ROLE THAT ENERGY DEVELOPMENT AND ENERGY CONSERVATION CAN PLAY IN MEETING THOSE NEEDS.

RURAL ECONOMIC DEVELOPMENT DEPENDS VITALLY ON ADEQUATE, RELIABLE ENERGY SUPPLIES, AND RURAL AREAS OFTEN HAVE UNIQUE PROBLEMS IN MEETING THEIR ENERGY REQUIREMENTS. THEY ARE FREQUENTLY LOCATED FAR FROM CONVENTIONAL ENERGY SOURCES, WHETHER THAT SOURCE IS A POWER PLANT OR AN OIL REFINERY. THUS, RURAL ENERGY COSTS TEND TO BE HIGHER AND THERE IS A GREATER LIKELIHOOD OF INTERRUPTION.

IN ADDITION, SINCE FARMING IS AN ENERGY-INTENSIVE OPERATION, THERE IS BOTH A GREAT INTEREST AND NEED IN DEVELOPING AND APPLYING NEW ENERGY TECHNOLOGY IN RURAL AREAS.

CURRENT FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT IN MANY OF THE RENEWABLE ENERGY TECHNOLOGIES IS DESIGNED TO PROVIDE A BASE FOR PRACTICAL COMMERCIAL APPLICATION IN AGRICULTURAL

AREAS. THOSE OFFERING PARTICULAR PROMISE INCLUDE TECHNOLOGIES WHICH PROVIDE ENERGY FROM AGRICULTURAL WASTE, FOREST WASTE, WIND ENERGY AND SOLAR THERMAL ENERGY. EFFECTIVE PLANNING CAN HELP RURAL AREAS TO LEAD THE NATION IN THE DEVELOPMENT OF ALTERNATIVE ENERGY TECHNOLOGIES.

I AM PROUD THAT FLORIDA IS A LEADER IN ENERGY CONSERVATION. IN 1980, THE LEGISLATURE PASSED THE FLORIDA ENERGY EFFICIENCY AND CONSERVATION ACT WHICH REQUIRED THE PUBLIC SERVICE COMMISSION TO SET ENERGY CONSERVATION GOALS FOR ELECTRIC AND GAS UTILITIES IN THE STATE AND REQUIRED THE UTILITIES TO DEVELOP PROGRAMS, INCLUDING HOME ENERGY AUDITS, TO MEET THOSE GOALS. THE FLORIDA BUILDING CODE WAS THE FIRST IN THE NATION TO USE A POINT SYSTEM TO ENCOURAGE BUILDERS TO FIND THEIR OWN PATHS

TO ENERGY EFFICIENCY. THE FLORIDA ENERGY EXTENSION SERVICE AND SCHOOLS AND HOSPITALS PROGRAMS HAVE BEEN VERY ACTIVE AND CONSIDERED BY MANY TO BE MODELS FOR OTHER STATES TO EMULATE. I AM INTERESTED IN LEARNING WHAT THE EFFECTS OF THIS FAR-SIGHTED LEGISLATION HAVE BEEN FOR FLORIDA'S RURAL COMMUNITY.

FINALLY, I WOULD LIKE TO CONGRATULATE DR. RICHBURG AND THE OTHER MEMBERS OF THE STEERING COMMITTEE FOR THEIR EXCELLENT WORK IN ORGANIZING AND CONDUCTING THIS ENERGY CONFERENCE. EVENTS SUCH AS THIS CAN PLAY A MAJOR ROLE IN FOCUSING ATTENTION ON THE ENERGY RELATED NEEDS OF RURAL AREAS, AND THE EXISTING TECHNOLOGIES AVAILABLE TO HELP MEET THOSE NEEDS. IT GIVES ME GREAT PLEASURE TO BRING THE ENERGY DEVELOPMENT AND APPLICATIONS SUBCOMMITTEE TO THIS BEAUTIFUL PART OF OUR STATE TO LEARN ABOUT "RURAL ECONOMIC DEVELOPMENT AND ENERGY."

AT THIS TIME I WOULD LIKE TO RECOGNIZE MY COLLEAGUE FROM THE STATE OF WISCONSIN, CONGRESSMAN SENSENBRENNER, THE RANKING MINORITY MEMBER OF THE SUBCOMMITTEE, FOR ANY COMMENTS HE WOULD LIKE TO MAKE.

Mr. FUQUA. It gives me a great personal pleasure to welcome our colleagues from the Energy Development and Applications Subcommittee to Marianna and Chipola Junior College, and I hope that your stay here will be both enjoyable, as well as enlightening.

I am also pleased to welcome our distinguished witnesses, many of whom are friends, to testify about the needs of rural America, such as this part of Florida, and the role that energy development and energy conservation will play in meeting those needs.

Rural economic development depends vitally on adequate, reliable energy supplies, and rural areas often have unique problems in meeting their energy requirements. They are frequently located far from conventional energy sources, with whatever that source is—the powerplant or oil refinery—and thus rural energy costs tend to be higher and there is a greater likelihood of interruption.

In addition, since farming is an energy-intensive operation, there is both a great interest and need in developing and applying the energy technology in rural areas.

Current federally sponsored research and development in many of the renewable energy technologies is designed to provide a base of practical commercial application in agricultural areas, and those offering particular promise include technologies which provide energy from agricultural waste, and forest waste.

I am proud that Florida is a leader in energy conservation. In 1980, the legislature, with the assistance of the Lieutenant Governor and the Governor, passed the Florida Energy Efficiency and Conservation Act, which required the public service commission to set energy conservation goals for electric and gas utilities in the State and required that the utilities develop programs including energy audits, to meet those goals, and the Florida building code, which was the first in the Nation with a point system to encourage builders to find their own paths to energy efficiency.

The Florida Energy Extension Service, and the school and hospital programs have been very active and considered by many to be models for other States to emulate, and I am interested in learning what effects this farsighted legislation has had on the Florida rural community.

Finally, I would like to congratulate Dr. Richburg and the other members of the steering committee for the excellent work in organizing and conducting this energy conference. Events such as this can play a major role in focusing attention on energy-related needs, and particularly of rural areas, and the existing technologies available to help meet those needs.

It gives me great pleasure to bring the Energy Development and Applications Subcommittee to this beautiful part of the State and learn about rural economic development and energy. At this time, I would like to recognize my colleague from the State of Wisconsin, Congressman James Sensenbrenner, who is the ranking minority member of the Subcommittee on Energy Development and Applications.

Jim, we are very pleased to have you with us, and have you in sunny Florida because it is going to be sunshine later today.

[The opening statement of Mr. Sensenbrenner follows:]

OPENING STATEMENT
OF THE

HONORABLE F. JAMES SENSENBRENNER, JR. (R-WIS.)

SUBCOMMITTEE ON ENERGY DEVELOPMENT AND APPLICATIONS
FIELD HEARING ON
RURAL ECONOMIC DEVELOPMENT AND ENERGY

APRIL 15, 1983
MARIANNA, FLORIDA

THANK YOU, MR. CHAIRMAN, FOR THIS OPPORTUNITY TO MAKE SOME REMARKS CONCERNING TODAY'S HEARING.

BEFORE EXPRESSING MY THOUGHTS ON THE SUBJECT OF TODAY'S HEARING, LET ME EXPRESS MY APPRECIATION TO THE RESIDENTS OF MARIANNA, AND THOSE ATTENDING THIS CONFERENCE, FOR THE HOSPITALITY THEY HAVE SHOWN. WE IN WISCONSIN LIKE TO REFER TO OUR PART OF THE COUNTRY AS "GOD'S COUNTRY", BUT FROM WHAT I HAVE OBSERVED, I CAN SEE THAT HE BLESSED THIS PART OF THE COUNTRY AS WELL. ALTHOUGH MY STAY IN THIS AREA WILL BE BRIEF, I HOPE THAT SOMEDAY I WILL BE ABLE TO RETURN AND SPEND MORE TIME.

THE CITIZENS OF THIS AREA SHOULD NOT ONLY BE PROUD OF THEIR HOSPITALITY AND THE BEAUTY OF THIS AREA, BUT ALSO OF THE CHAIRMAN OF THE SUBCOMMITTEE AND FULL COMMITTEE, DON FUQUA. DON IS HELD IN HIGH ESTEEM BY HIS COLLEAGUES IN THE CONGRESS. HE IS RESPECTED NOT ONLY FOR HIS INTEGRITY AND INTELLIGENCE, BUT, MORE IMPORTANTLY FOR MEMBERS FROM THIS SIDE OF THE AISLE, FOR HIS WILLINGNESS TO LISTEN TO AND PROTECT THE INTERESTS OF

THE MINORITY MEMBERS OF THE COMMITTEE. THE CITIZENS OF THIS AREA CAN BE PROUD OF THEIR REPRESENTATIVE TO CONGRESS.

THE SUBJECT OF TODAY'S HEARING IS OF GREAT INTEREST TO ME. THE DISTRICT THAT I REPRESENT IS OVER 50 PERCENT RURAL. WHILE THE AGRICULTURAL ACTIVITIES OF OUR DISTRICTS MAY DIFFER, WE SHARE A COMMON INTEREST IN THE CONTINUED SUPPLY OF ENERGY TO THESE AREAS.

WISCONSIN CONSUMERS' ENERGY COSTS IN '1982 TOTALED $8.1 BILLION, APPROXIMATELY $1,700 PER PERSON. OF THIS AMOUNT, APPROXIMATELY 25 PERCENT WAS USED BY RESIDENTIAL CUSTOMERS, AND 4 PERCENT FOR AGRICULTURE. GASOLINE AND DIESEL FUEL ARE THE MAIN ENERGY REQUIREMENTS, ACCOUNTING FOR 75 PERCENT OF AGRICULTURAL ENERGY USE. NOT ONLY IS THE HIGH COST OF THIS ENERGY A BURDEN ON INDIVIDUALS AND A DETRIMENT TO THE GENERAL HEALTH OF THE STATE'S ECONOMY, BUT THE CONTINUED DEPENDENCE ON FOREIGN ENERGY SUPPLIES KEEPS US VULNERABLE TO ACTIONS AND ACCIDENTS IN PARTS OF THE WORLD BEYOND OUR CONTROL. WE MUST, THEREFORE, SEEK TO ENCOURAGE THE DEVELOPMENT OF ENERGY RESOURCES WITHIN THIS COUNTRY.

I LOOK FORWARD TO YOUR THOUGHTS ON THIS SUBJECT.

Mr. SENSENBRENNER. Thank you very much, Mr. Chairman.

I was somewhat deceived by the chamber of commerce advertisements when I arrived at the airport and got soaked last night, but I am sure things will change.

I also appreciate this opportunity to make some remarks concerning today's hearings. Before expressing my thoughts on the subject of today's hearings, let me express my appreciation to the residents of Marianna and to those attending this conference, for the hospitality they have shown.

We in Wisconsin like to refer to our part of the country as God's country, but from what I have observed I can see that he has blessed this part of the country as well. Although my stay in this area will be brief, I hope that some day I will be able to return and spend some more time here.

The citizens of this area should not only be proud of their hospitality, this college and the beauty of this area, but also the chairman of the Subcommittee and Full Committee on Science and Technology, Congressman Don Fuqua. Don is held in high esteem by his colleagues in the Congress. He is respected not only for his integrity and intelligence, but more importantly, for members from this side of the aisle, his willingness to listen to and to protect the interests of the Republican members of the committee. The citizens of this area can be proud of their representative to Congress.

The subject of today's hearing is of great interest to me. The district in Wisconsin that I represent is over 30 percent rural. While the agricultural activities of our districts may differ, we share a common interest in the continued supply of energy to these areas.

Wisconsin consumers' energy costs in 1982 totaled $8.1 billion, for approximately $1,700 per person. We have a little bit higher heating cost in my part of the country.

Of this amount, approximately 25 percent was used by residential customers, and only 4 percent for agriculture. Gasoline and diesel fuel are the main energy requirements, accounting for 75 percent of agricultural energy use.

Not only is the high cost of this energy a burden on individuals and a detriment to the general health of Wisconsin's economy, but the continued dependence on foreign energy supplies keeps us vulnerable to actions and accidents in parts of the world beyond our control.

We must, therefore, seek to encourage the development of energy resources within this country, and I look forward to the witnesses' thoughts on this subject.

Thank you, Mr. Chairman, very much.

Mr. FUQUA. Thank you very much, Jim.

We are also very happy to have our colleague, Bill Nelson, who represents the Orlando, Brevard County area, but we are counting him as one of our north Floridians because his roots go very deep into our adjacent county to the west, Washington County.

Bill, we are very happy to have you here with us today.

Mr. NELSON. Thank you, Mr. Chairman.

I want to say that my interest in energy development in rural parts of our country actually was stimulated 11 years ago, when I came to the State legislature in Tallahassee, and as a member of the same appropriations subcommittee, was the gentleman sitting

over there at the other table, who was then the State representative from Jackson County.

Soon thereafter I had the privilege of being the chairman of one of those appropriations subcommittees, of which Wayne was a member, and we always had in our midst an articulate spokesman for the rural parts of our state. So I am looking forward to the Governor's testimony this morning. I am very privileged and pleased to be here with you.

I had the good fortune of spending last night with my 94-year-old grandmother, 6 miles south of Chipley, out near Orange Hill, and I had four helpings of acre peas and cornbread. So I am in good shape today. All of the Nelsons in Washington County are my kinfolks, and I am delighted that you had this hearing in a part of this country where we can get testimony firsthand concerning the energy needs in rural America.

Thank you, Mr. Chairman, for that.

Mr. FUQUA. Thank you very much, Bill.

[The opening statement of Mr. Lewis follows:

STATEMENT BY THE HONORABLE MR. TOM LEWIS

ENERGY DEVELOPMENT AND APPLICATIONS SUBCOMMITTEE

FIELD HEARING - ENERGY AND RURAL DEVELOPMENT

MARIANNA, FLORIDA

APRIL 15, 1983

THANK YOU, MR. CHAIRMAN, FOR THIS OPPORTUNITY TO WELCOME OUR WITNESSES TO TODAY'S HEARING. MANY OF THEM I KNOW PERSONALLY THROUGH MY SERVICE IN THE FLORIDA STATE LEGISLATURE, AND I LOOK FORWARD TO HEARING THEIR COMMENTS AND CONCERNS ABOUT FLORIDA'S FUTURE ENERGY NEEDS AND CAPABILITIES, PARTICULARLY AS THEY APPLY TO AGRICULTURAL AREAS.

I ALSO WANT TO EXPRESS MY APPRECIATION TO THE CITIZENS OF MARIANNA AND TO THE CONFERENCE PARTICIPANTS FOR THEIR WARM HOSPITALITY. FIVE YEARS AGO, I WAS IN MARIANNA FOR AN HRS HEARING, AND, MR. CHAIRMAN, I AM PLEASED TO HAVE THE OPPORTUNITY TO RETURN HERE TODAY TO DISCUSS THE IMPORTANT ISSUE OF ENERGY DEVELOPMENT IN RURAL AREAS.

A LARGE PART OF MY OWN CONGRESSIONAL DISTRICT IS VERY SIMILAR TO THE RURAL AGRICULTURAL AREA WHICH SURROUNDS MARIANNA. THEREFORE, THIS ENERGY ISSUE STRIKES CLOSE TO THE HEART OF MANY OF THOSE PEOPLE I REPRESENT IN THE U.S. CONGRESS.

FINALLY, I WANT TO ASSOCIATE MYSELF WITH THE REMARKS MADE BY THE GENTLEMAN FROM WISCONSIN ABOUT THE CHAIRMAN OF THIS SUBCOMMITTEE, WHO ALSO SERVES AS THE CHAIRMAN OF THE FULL SCIENCE AND TECHNOLOGY COMMITTEE. I HAVE KNOWN DON FOR A NUMBER OF YEARS, AND I HAVE THE HIGHEST REGARD FOR HIM AS A PERSON AND AS A COLLEAGUE. HIS WISE AND JUDICIOUS MANNER MAKES HIM AN EXTREMELY EFFECTIVE CHAIRMAN OF THE ONLY COMMITTEE IN CONGRESS WITH SOLE RESPONSIBILITY FOR ALL SCIENTIFIC RESEARCH AND DEVELOPMENT PROGRAMS FUNDED BY THE FEDERAL GOVERNMENT. MARIANNA IS INDEED FORTUNATE TO HAVE A PERSON OF HIS CALIBER AS THEIR REPRESENTATIVE.

THANK YOU, MR. CHAIRMAN.

Mr. Fuqua. Now, our first keynote witness will be our Lieutenant Governor of Florida. I know in Jackson County and this area, he needs no introduction.

Those of you who might not be familiar, he has had a very distinguished public service career. He is a practicing farmer, not far from here. He served in the State legislature, he is in his second term as Lieutenant Governor, and is the secretary of commerce in the State of Florida, and that handles a rather broad spectrum of activities that are very important to us, of which energy is very much one of them.

Lieutenant Governor, we are very pleased to have you here today, and appreciate hearing from you at this time.

STATEMENT OF HON. WAYNE MIXSON, LIEUTENANT GOVERNOR OF THE STATE OF FLORIDA

Mr. MIXSON. Don, thank you very much.

Mr. FUQUA. You indicated you had a prepared statement. If you wish to submit that for the record, we will take it. If you wish to summarize, we will be pleased to hear you any way you wish to do it.

Mr. MIXSON. I can do that, Don. I think that you have, we have copies that have already been submitted to you. I think I will just do that, just kind of summarize and touch some of the spots.

But first let me say how thrilled we are, Dr. Richburg, and you at Chipola, for sponsoring this conference, and, Congressman Fuqua, in your capacity that you would bring this very important

conference, which is directly, the future of the State of Florida certainly will depend largely on how we deal with these four E's, which is the subject matter of this conference, and we are happy to have it here in west Florida. It is nice to be here.

We are proud of Don Fuqua, all of us, and his leadership, and the importance of what he is doing in Washington and his being a partner with us in the State of Florida promises a great promise, because in the field of science and technology, we have our eyes set on the stars. We have had our eyes set on the stars a long time.

We have been shooting for those stars, literally, with all of the kind of hardware that we are putting up in our state, and this space age imagery, this space age technology, which become firsthand working knowledge for us, is going to become the industry of the future.

The things that we are going to do, the jobs that are going to be created, the things we are going to sell and serve the Nation, and our Nation and the world are going to be related to this knowledge industry, and we have staked out the progress that we have made thus far and would like to build on that for the economy of our State and the future.

It is the goal of Governor Graham, as Governor, to take the technology that is known thus far, to encourage our universities and our colleges and our schools to pick up, to become more proficient in sciences and mathematics and engineering, and in technology, and to be able to wed them together.

I saw a logo yesterday that had three hands, the university campus, the business community, and research, all tied together, government, all tied together, and that is what we are trying to do, to wed the business community and the college campuses closer, so that there is a rapid transfer of the technology and energy, and in all other kinds of technology that we will be using to produce the kinds of things that we will be producing in the future.

We are proud of Congressman Fuqua and his role in this effort and its potential for serving Florida. We are going to work. He works closely with us and we hope that we will work closely with him, because a lot of the money is being spent for research and development of military in our State. We want to see how fast we can transfer the turret, the CAT scan gear that puts you in that whirling machine and gets you a picture of your brain and all of your body and so forth.

It is my understanding that it is simply the gears off the turret of a tank or something like that, where we got that kind of technology. The transfer of technology from military to practical use for our consumer goods and health-related support systems is out there, and we want to make that transfer rapidly.

That is a goal for the kind of economy that we would like to build in Florida. That is a goal for most States. It is beautiful, it is intriguing, it is dramatic, we believe, but we have got a leg up.

We enjoy the distinction of being the State that has the No. 1 business climate in the Nation. I don't ever talk to anybody without showing it. You can see it in the television cameras and so forth, the No. 1 business climate, and we want to take that business climate and move rapidly to do these kind of things in our State, and provide the kind of support system to bring that about.

22-639 O - 83 - 2

Bill Nelson is very kind and generous. And I want you to look at that guy, if he ever amounts to anything—and he is coming along pretty well—He has been a protege of mine for a long time. I have had my money on him and anybody that looks like that and has an Ivy League education and talks like that, and likes vittles like that, you better watch him. He has got a broad base. I would say he is a real comer. I am betting on him.

Congressman Sensenbrenner, we apologize. This is unusual weather. We generally do have sunshine, but isn't this unusual for us to have a Republican visit us? [Laughter.]

Mr. MIXSON. Especially a high-level Republican.

Mr. SENSENBRENNER. The scripture says you are supposed to preach the gospel to the ends of the world, so I am here today to do that. [Laughter.]

Mr. MIXSON. It also says that it will rain on the just and the unjust alike. But somebody said if it would just rain on the unjust, we could take a dipper and water the just. I don't know if that is true. Enough of that.

Thank you for being with us. We genuinely appreciate that.

In Florida, the energy act that the Congressman referred to earlier has been spectacularly successful, far more than many of us believed.

In 1980, in trying to get that legislation passed—Vicki, you remember how many times the members of the legislature ate Lucille's Chinese food at my house while we were trying to persuade them to pass this legislation, and the press has said it was stuck together with Chinese food. But there was some promise there. The success has been spectacular.

Florida is an energy dependent State. We must have available energy, and it must be affordable for the industry that we are talking about, the businesses, and the agriculture which is our basic industry. The way we are going to achieve that is through two courses, in my judgment. One is through conservation. There is more room for conservation than we thought.

We have saved more energy and made more efficient use of energy, without denying ourselves of the product of transportation and jobs, than we ever dreamed we could. We are not through with that. We can continue to make more conservation efforts without really denying ourselves the kind of activity which will support our economy.

We also have to deal more effectively with renewable resources, renewable energy sources, and I think that here again, just after 2 or 3 years, there is more promise than we ever thought that was out there.

I think we have to continue to adjust our values, our own ideas about—there is an energy ethic. It takes me a while to learn, too. We used to talk about an energy ethic. I didn't know it could be instilled as fast. Mabye we haven't adopted it to its ultimate extent.

I was in Mullheim, Germany, and you have been, and seen Dr. Ludwig, who is head of the Seimens operation there which builds steam-generating turbines and energy equipment. He said one day a couple of years ago,"I personally will build you a steam turbine

that can be driven by water, steam that is heated by coal, or by petroleum, or by nuclear power."

But, he said, "I personally believe it ought to be an international crime to heat water with scarce petroleum products." He was stating another ethic there. He said, "That is not an efficient way to use petrolum, ultimately."

I am not talking about the petrolum people that are here supporting this conference, but the idea is that there are so many other things that we can do with scarce petroleum in the chemical world and so forth, as it gets scarcer. We ought to find ways to create renewable energy, and to use it and preserve our energy.

That is going to be our hope in Florida, if we build our environment and build the educational system, if we retain our environment, which is our biggest asset in this State. It is related to economic development.

While we know that the company who made this study used 22 quantifiable factors to conclude that we are the best business climate in the Nation, nobody would deny that the real reason more people come to Florida than anywhere else is simply because of our environment, Congressman, the environment that we have been able to build and preserve, and that we are committed to continue to preserve. So all of these are tied together.

We are now in a crash commitment to increase the educational systems in our State. When President Kennedy said in 1960–61 "we are going to put a man on the Moon by 1970," that was a national commitment of some importance which has had all kinds of lasting influence and positive effects on science and technology and on our military and on our pride, and all those kinds of things. You have to make a commitment. You have to make a commitment, and you have to have goals.

Now, we have said that our goal is, among the other goals, to remain energy efficient in this State, to build an economy, and now to build an educational system. We are solidly committed to moving this State into the top quartile of the States by 1985, 2 years away, and we are a long way from the moon, but we are working toward achieving those goals. They are all in some way tied together: energy and economic growth is all important and tied together.

I was reading here, and I am going to just summarize through these notes.

Petroleum was almost 70 percent of our State's total energy supply in 1978. I was talking a while ago about petroleum dropping to the low sixties by the beginning of this year. Look what we have done.

In the process of doing this, as we have resorted to other sorts of energy, among the dramatic things, as well as using more coal and trying to clean up our use of coal, there is some dramatic progress. I think that maybe Jim Lee and others are going to talk about the wood.

We have a rapid growing source of wood. If you don't know how that adds up, you can grow a tree in our area to cutting size in what—20, 25, or 30 years. If you get to northwest California and you want to grow that tree to a cutting size, which has some relationship to how much wood you can produce per acre per year, it

takes 60 years. You move up further into Canada and it takes 100 years to produce that same tree.

We have tremendous ability to produce wood products. We can grow crops almost for wood.

We have been retrofitting the heating system over here at Florida State Hospital, and another one down in Baker County to use wood chips instead of coal or petroleum, which we have been heating with. I don't know if you know about that or not, but we are about ready now.

These wood chips are going to be made in a factory down in Liberty County, and we are going to be able to save over the next 20 years about $60 million in the cost of heating, the energy costs for the boilers, and for those two institutions almost $3 million a year, and at the same time use a renewable source of energy, which will create jobs at home in the process of doing that.

I am summarizing and I cannot pick it up here precisely, but I was suprised to see that the energy costs for these four counties, Calhoun, Jackson, Washington, and Liberty County, last year was—if I could find it in these notes that I am running through and have not marked very well—something like $54 million.

Just think about a 10-percent saving in that much cost of energy per year would put $5 million more in the pockets of the people in these four or five counties, and what can we do in the way of investing to create more jobs, or consumer services, with that much money?

Congressman, I see, that figure was a $55.8-million savings over 20 years.

We have all of the wood products. We have biomass in tremendous quantitites available in this State.

Not very long ago, I visited Kaplan Industries down in Polk County and their feed yard, a feed lot. I run a feed lot operation myself, 15, 10, 12 miles from here. They take the manure daily from that feed lot and scrape it into ponds, and it grows some sort of a bacteria which generates a certain amount of gas when they get it into the system. Now they are, of course, using that gas to make electricity for their own slaughtering operation, their own feed lot operations and selling some of it into the system there.

Of course, another source of energy that we are still excited about the potential for is solar. These little photovoltaic cells are the most fascinating thing I have seen in a long time. And you have all promoted them. They power our satellites, but I didn't know how practical they were. Of course, they are still expensive, but if we ever learn how to make them cheap enough, just look at what they will do.

One day about a year ago, when I was down in Cape Canaveral and looking at our State energy research center down there, I went into a full size three-bedroom home, and it was very cool. It was a very hot day, the sun shining brightly. It was in the summertime, and the home was very, very cool and the lights were all on, the refrigerator was running, and all of the appliances that you would normally have in a home. The only difference was that all of the electricity was being generated on a panel up on the roof, which was on one side of the roof of that house.

Not only was it generating all the electricity for that house, but they had two meters in the garage and I went out and looked at those meters. One of them was running forward to measure how much actual energy was being consumed in that home, and the other was running backward, because the solar cell was producing too much energy, Bill, and sending it back into the power system. They were getting a credit, Bill, because they were shipping power back into the system.

Now, all of these things, they are not right upon us. We have got to spend the money. We have got to continue to do the kinds of research that would bring these things, make them available to us.

But, Congressmen, if one thing impresses me, even though I was the guy who was personally paying for the Chinese food to try to get some of these things passed 3 years ago, I was perhaps the greatest skeptic. Vicki, you know I was. I couldn't sell very well because I didn't believe it was going to have the kind of payback that it did, the short-term payback.

So when these folks are spending your money on that kind of scientific research in some areas, I have become a believer myself, because I know the great variety of paybacks and how immediate, those paybacks are.

We are highly dependent on that. We are an energy-dependent State, as I said before, and we have made a lot of progress through conservation. We are getting a lot of mileage out of nontraditional sources of energy, and we don't want to quit using energy. We are hooked on it as a nation. We like our air-conditioning, we like our automobiles. We have got to have energy because it is the No. 1 consideration.

You know, they made the study, and they said we were No. 1 in the Nation. One of those things they looked at, we are not the best source of energy but we do have energy available and it is still affordable.

But we, fortunately, are living in a world now where petrolum prices are coming backward. We know how dependent we are and we know how the thin line of our economy hangs on affordable and available energy, because in 1974 and 1975, when we plunged very deeply into a recession, a lot of it was because people didn't know whether they could get gasoline, or tourists who spend $1 billion in sales tax a year, the equivalent of over 2 percent sales tax, that spend money here. So availability of energy at a cost that people think is affordable, no State in the Union is more totally dependent upon it than we are.

We are happy that you are here and giving consideration to these things which are very vital to us. Again, thank you for being here in Marianna.

[The prepared statement of Mr. Mixson follows:]

PREPARED STATEMENT OF WAYNE MIXSON

ENERGY IS A BASIC FACTOR OF MODERN SOCIETY. IT FUELS ECONOMIC GROWTH AND GENERATES WEALTH, THEREBY INDIRECTLY SHAPING SOCIAL AND GOVERNMENTAL INSTITUTIONS.

IN SHORT, IT IS THE QUALITY NOT QUANTITY OF AVAILABLE ENERGY THAT SHAPES INDIVIDUAL LIFESTYLES--WHERE PEOPLE WORK, WHERE THEY PLAY AND WHERE AND HOW THEY LIVE.

WITH ONE OF THE FASTEST-GROWING POPULATIONS IN THE NATION, FLORIDA HAS LONG RECOGNIZED THE NEED FOR ONGOING PROGRAMS TO ENSURE THAT THE ENERGY DEMANDS OF THE FUTURE WILL BE MET. ENERGY MUST BE BOTH AVAILABLE AND AFFORDABLE FOR INDUSTRIAL AND RESIDENTIAL USE.

THE STATE OF FLORIDA BELIEVES THAT ENERGY CONVERSATION, THE INCREASINGLY EFFICIENT USE OF ENERGY, AND ECONOMIC GROWTH, GO HAND IN HAND. FLORIDA IS RECOGNIZED NATIONALLY FOR OUR STRONG PROGRAMS PROMOTING ENERGY EFFICIENCY.

INCREASED ENERGY EFFICIENCY WILL CONTINUE TO BE NECESSARY IF FLORIDA IS TO COMBINE ECONOMIC GROWTH AND MODERATE DEMAND FOR ENERGY. ENERGY EFFICIENTY, THEREFORE, MUST BE A STRONG COMPONENT OF ECONOMIC DEVELOPMENT.

THE CITIZENS OF JACKSON, LIBERTY, CALHOUN, WASHINGTON AND HOLMES COUNTIES ARE VERY FAMILIAR WITH THE ROLE ENERGY PLAYS IN THEIR ECONOMIC WELL-BEING. ACCORDING TO A RECENT STUDY BY THE FLORIDA ECONOMIC DEVELOPMENT CENTER AT FSU...THE FARMS BUSINESSES AND HOMES OF THE FIVE COUNTY AREA SPEND OVER $43 MILLION A YEAR ON DIRECT ENERGY COSTS.

CONTROLLING THESE ENERGY COSTS ALLOWS SOME OF THIS MONEY TO BE SPENT ON OTHER THINGS. IMAGINE THE ECONOMIC IMPACT A SAVINGS OF ONLY 10 PERCENT OF THE TOTAL COSTS OF ENERGY WOULD HAVE IN THAT FIVE COUNTY AREA.

NORTHWEST FLORIDA IS EAGER FOR NEW, CLEAN INDUSTRIAL GROWTH. THE FLORIDA DEPARTMENT OF COMMERCE, WORKING IN CONJUNCTION WITH LOCAL GOVERNMENTS AND ECONOMIC DEVELOPMENT ORGANIZATIONS IS AGGRESSIVELY TRYING TO BRING THAT INDUSTRY HERE. ONE OF THE TOP SELLING POINTS AN AREA HAS IS ITS ABILITY TO PROVIDE ENERGY AT REASONABLE COST.

THE PRICE OF ENERGY IS A MAJOR COST OF ALMOST ANY KIND OF BUSINESS. THE ALEXANDER GRANT REPORT OF BUSINESS CLIMATES, WHICH RANKED FLORIDA NUMBER ONE IN THE NATION, INDICATED THAT MANUFACTURERS CONSIDER AVAILABILITY AND COST OF ENERGY TO BE THE NUMBER ONE FACTOR IN LOCATING AN INDUSTRIAL PLANT.

DESPITE RECENT DECREASES IN THE PRICE OF CERTAIN KINDS OF ENERGY, NOTABLY PETROLEUM-BASED RESOURCES, FLORIDA BELIEVES THERE ARE STILL OTHER RESAONS FOR A SOUND ENERGY PROGRAM.

IN THE NOT-TOO-DISTANT PAST WE LEARNED WHAT FLUCTUATIONS IN ENERGY SUPPLIES CAN DO TO THE PILLARS THAT HAVE TRADITIONALLY SUPPORTED FLORIDA'S ECONOMY--TOURISM, AGRICULTURE AND CONSTRUCTION.

THOSE FLUCTUATIONS DEMONSTRATED THE NEED FOR AN ONGOING EFFORT TO REDUCE FLORIDA'S DEPENDANCE ON PETROLEUM-BASED FUELS. IN 1979, WE ESTABLISHED A GOAL OF REDUCING PER CAPITA ENERGY CONSUMPTION BY 25 PERCENT, AND IT NOW APPEARS WE WILL REACH THAT GOAL BY THE END OF THIS DECADE.

PETROLEUM CONSTITUTED ALMOST 70 PERCENT OF THE STATE'S TOTAL ENERGY SUPPLY IN 1978, BUT DROPPED TO THE LOW 60's BY THE BEGINNING OF THIS YEAR.

THE PROGRESS WE HAVE MADE SO FAR HAS HELPED TO MAKE SOME RECENT ECONOMIC HARD TIMES A LITTLE LESS HARD TO BEAR AND CREATED A BASE FOR FUTURE ECONOMIC GROWTH.

ALTHOUGH MUCH HAS BEEN DONE, GREAT POTENTIAL FOR COST-EFFECTIVE ENERGY CONSERVATION REMAINS TO BE TAPPED. THE MANY EXPERTS AT THIS CONFERENCE WILL PRESENT A WIDE VARIETY OF OPTIONS RANGING FROM MORE EFFICIENT APPLIANCES AND MACHINERY TO NEW RESOURCE-BASED INDUSTRY THAT COULD HAVE A PARTICULARLY POSITIVE IMPACT ON ECONOMIC DEVELOPMENT IN NORTHWEST FLORIDA.

AT THE RISK OF OMITTING MANY WORTHY PROGRAMS, I WOULD LIKE TO MENTION SOME OF THE NEW TECHNOLOGIES THAT FLORIDA IS NOW INTEGRATING INTO ITS RESIDENTIAL AND COMMERCIAL SECTORS.

THE STATE OF FLORIDA HAS ENDORSED ACCELERATED UTILIZATION OF ALTERNATE ENERGY SOURCES. WE HAVE RECOGNIZED THE NEED FOR DIVERSIFICATION OF THE STATE'S ENERGY SOURCES WITH PARTICULAR EMPHASIS ON RENEWABLES.

THE STATE IS ESPECIALLY INTERESTED IN THE USE OF RENEWABLE RESOURCES AND NEW TECHNOLOGIES. WE HAVE BEEN IMPLEMENTING DEMONSTRATION AND RETROFIT PROJECTS IN THE PUBLIC SECTOR, STIMULATING AND MONITORING ACTIVITY IN THE PRIVATE SECTOR AND CONDUCTING ONGOING RESEARCH AND DEVELOPMENT PROJECTS.

WE ARE PARTICULARLY ATTUNED TO THE WORK OF THE BIOMASS RESEARCH CENTER AT THE UNIVERSITY OF FLORIDA. BIOMASS, ENERGY DERIVED FROM PLANTS AND ANIMALS, HOLDS PARTICULAR POTENTIAL FOR NORTHWEST FLORIDA BECAUSE OF THE VAST STANDS OF TIMBER AND THE AMOUNT OF AGRICULTURAL ACTIVITY IN THE AREA.

ALTHOUGH WOOD FROM SAWMILL AND LOGGING OPERATIONS IS NOW THE PRIMARY BIOMASS RESOURCE USED TO PRODUCE ENERGY, RESEARCH IS NOW UNDER WAY INTO ALTERNATIVES. THE BIOMASS RESOURCE BASE OF THE FUTURE WILL INCLUDE RESIDUES FROM AGRICULTURAL, FORESTRY AND LIVESTOCK OPERATIONS, GRAINS AND OTHER SUGAR CROPS, AND WOODY, HERBACEOUS AND AQUATIC CROPS GROWN SPECIFICALLY FOR THIS PURPOSE.

AN AREA OF PARTICULAR INTEREST IS THE USE OF WOOD AS A FUEL. WOOD HAS A NUMBER OF ADVANTAGES AS A SOURCE OF ENERGY. IT'S RENEWABLE, SO WE DON'T EVER HAVE TO RUN OUT; IT IS GROWN IN FLORIDA, SO THE MONEY WE PAY FOR IT STAYS IN THE STATE; IT IS INEXPENSIVE BECAUSE WASTE PRODUCTS ARE USED; AND, IT IS ENERGY EFFICIENT.

PRIVATE INDUSTRY IS ALREADY UTILIZING WOOD AS AN ENERGY SOURCE IN NORTHWEST FLORIDA. AN EXAMPLE IS THE NATIONAL BY-PRODUCTS COMPANY, A MEAT-RENDERING FIRM BASED IN MARIANNA. THIS COMPANY HAS INSTALLED A WOOD-FIRED BOILER THAT USES TWO TONS OF WOOD AND WOOD BY-PRODUCTS FOR STEAM.

A SIMILAR WOOD-FIRED BOILER WAS RECENTLY INSTALLED BY THE ST. JOE PAPER COMPANY. OTHER SMALL INDUSTRIAL APPLICATIONS OF WOOD ENERGY IN FLORIDA ARE A WOOD GASIFIER AT THE FLORIDA POWER CORPORATION GENERATING PLANT AT ELLAVILLE; AND THE BUCKEYE CELLULOSE PLANT NEAR PERRY WHICH RECENTLY DECREASED ITS DEPENDENCE ON FOSSIL FUELS BY 38 PERCENT.

THE BOILERS OF TWO LARGE INSTITUTIONS RUN BY THE STATE OF FLORIDA ARE CURRENTLY BEING CONVERTED TO BURN WOOD. THEY ARE THE UNION CORRECTIONAL INSTITUTION AT RAIFORD AND THE FLORIDA STATE HOSPITAL AT CHATTAHOOCHEE. PRISON OFFICIALS ESTIMATE FUEL COST SAVINGS OF $55.8 MILLION OVER 20 YEARS. HOSPITAL OFFICIALS BELIEVE FUEL COSTS WILL BE REDUCED BY 158 PERCENT AFTER THE WOOD CONVERSION IS COMPLETED THIS YEAR.

IT SHOULD BE NOTED THAT THE DENSIFIED WOOD PELLETS THAT ARE BEING USED BY THE HOSPITAL ARE BEING PRODUCED IN HOSFORD--ANOTHER EXAMPLE OF A RESOURCE-BASED INDUSTRY RESULTING FROM THE APPLICATION OF NEW TECHNOLOGY.

DEVELOPMENTAL WORK ON EXTRACTING USABLE ENERGY FROM CROP RESIDUES, A TECHNOLOGY RELATED TO BIOMASS, IS CURRENTLY UNDER WAY AT THE INSTITUTE OF FOOD AND AGRICULTURAL SCIENCES AT THE UNIVERSITY OF FLORIDA.

THIS PROCESS CONVERTS ANIMAL MANURE TO METHANE GAS WHICH IS THEN BURNED TO GENERATE ENERGY.

RESEARCH INTO THE POSSIBLE USES OF ALCOHOL AS A FUEL IS ALSO ONGOING. THE FLORIDA DEPARTMENT OF AGRICULTURE AND CONSUMER SERVICES HAS BEEN WORKING CLOSELY WITH POTENTIAL MAJOR ALCOHOL PRODUCERS INTERESTED IN ESTABLISHING OPERATIONS IN FLORIDA FOR THE PAST SEVERAL YEARS.

A STILL-EMERGING RENEWABLE RESOURCES INDUSTRY THAT HOLDS PARTICULAR PROMISE FOR THE SUNSHINE STATE IS SOLAR ENERGY. WHILE THIS TECHNOLOGY HAS BEEN IN EXISTENCE FOR YEARS, MORE RESEARCH IS NEEDED TO MAKE IT COST-EFFECTIVE.

IN THE COMING YEARS, HOWEVER, SOLAR ENERGY WILL CERTAINLY PLAY A SIGNIFICANT ROLE IN REDUCING OUR DEPENDENCE ON FOSSIL FUELS. THE FLORIDA SOLAR ENERGY CENTER RECEIVED A MAJOR GRANT FROM THE U.S. DEPARTMENT OF ENERGY IN 1982, ESTABLISHING THE CENTER AS ONE OF THREE MAJOR SITES IN THE U.S. FOR TESTING RESIDENTIAL APPLICATIONS OF SUNLIGHT AS AN ENERGY SOURCE.

A TECHNOLOGY THAT HAS BEEN IN EXISTENCE FOR MANY YEARS IN FLORIDA IS CO-GENERATION--USING THE POWER OF THE SUN FOR WATER HEATING OR SPACE CONDITIONING. THERE WAS A TIME WHEN MOST OF THE HOMES IN MANY PARTS OF THE STATE WERE EQUIPPED WITH SOLAR-BOOSTED WATER HEATING SYSTEMS, AND THIS PROCESS WILL FIND MANY APPLICATIONS IN THE FUTURE.

THE STATE IS EXPANDING ITS TECHNICAL ASSISTANCE IN THIS AREA TO LOCAL GOVERNMENTS AND THE COMMERCIAL AND INDUSTRIAL SECTORS.

TWO OTHER AREAS OF FUTURE INTEREST AS ALTERNATIVE ENERGY SOURCES ARE HYDROPOWER AND THE WIND. WHILE THESE TECHNOLOGIES HAVE LIMITED APPLICATION IN FLORIDA AT THE PRESENT TIME, WE ARE MONITORING RESEARCH INTO BOTH OF THEM.

IN THE CASE OF HYDROPOWER, THE GOVERNOR'S ENERGY OFFICE IDENTIFIED 22 SITES IN THE STATE WITH THE POTENTIAL GENERATING CAPACITY OF AT LEAST 100 KILOWATTS. IN THE CASE OF WIND-GENERATED ENERGY, WINDMILLS AND WIND DRIVEN GENERATORS HAVE BEEN EXEMPTED FROM PROPERTY TAX ASSESSMENTS.

BIOMASS, CO-GENERATION, SOLAR, WIND AND HYDROPOWER ARE JUST SOME OF THE POSSIBILITIES THAT LIE BEFORE US AS WE SEEK TO FIND READY, COST-EFFICIENT ENERGY SYSTEMS IN THE FUTURE.

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FOR OVER 200 YEARS, PIONEERS AND MODERN AMERICANS HAVE LIVED THROUGH TRANSITIONS AS ENERGY SOURCES CHANGE THEIR LIVES--FIRST WOOD, THEN COAL, OIL AND GAS, AND NOW THE RENEWABLES. ENERGY IS ONCE AGAIN AT THE HEART OF A TRANSITION CAUSING CHANGES IN OUR LIVES, IN THE WAY WE THINK ABOUT OUR ENVIRONMENT.

FLORIDA HAS SHOWN THAT IT IS READY AND WILLING TO FACE THE ENERGY CHALLENGES OF THE FUTURE. WE'VE COME A LONG WAY, BUT WE'VE STILL GOT A WAY TO GO.

Mr. FUQUA. Thank you very much, Governor.

Mr. Sensenbrenner, any questions?

Mr. SENSENBRENNER. Thank you very much, Governor.

In your prepared statement, you state that one of the cornerstones of Florida energy policy is a conservation effort. As you know, this committee has authorized a substantial amount of money for energy conservation activities over the years.

Those activities are coming under increasing criticism in Washington because when you add the amount of money that is spent on insulation and improved efficiency of furnaces, plus the administrative cost, you could heat a whole house with the windows open for a northern winter many times over. Consequently, the cost effectiveness of energy programs is casting doubt on the conservation programs themselves.

Have you developed an answer here in the State of Florida to this criticism that I think will be harder, moreover, as the Federal budget deficit balloons?

Mr. MIXSON. I don't think we have. I think that our best hope to achieve this is that peoples' memories be a little bit longer—now that we are going, maybe going back to bigger automobiles, and we say, well, it doesn't cost that much, like you said, it doesn't cost that much now, a little leakage.

Incidentally, when my electric current bill went to $240 month last year, I got outside and physically felt all the cracks to see if I could feel any cold air coming out. Now I get inside and feel any cold air coming in. So it is an insulation process.

I think that we are still having a reasonable amount of compliance. Much ought to be said for Bill Demmon and others, for our

utilitiy companies in Florida. They have enthusiastically embraced and supported these energy-conserving efforts, and I don't think that we are ready to abandon our commitment to register a few more increments of conservation.

There are two ways, you know, trying to produce plenty by all kinds of sources of energy, but we ought not to write off conservation because there are not just the economies that are generating and saved in the personal home. That is the point you are making, the national economy, by the importation of petroleum products and so forth, and the net resulting cost to the Nation as well as to the individual.

We have to continue to commit ourselves and find ways to support these conservation measures through tax incentives and so forth, which we have done in Florida. We have made it a little more palatable that way.

Mr. SENSENBRENNER. Thank you.

Mr. FUQUA. Congressman Nelson?

Mr. NELSON. Thank you, Mr. Chairman.

Governor, there is a debate in Washington basically over the fact of alternative energy sources to oil, whether or not we should develop these through private industry being the main source of the fund for the development of the alternative sources, or whether or not the role of the U.S. Government should be there in full force through dollars that we appropriate for the actual research and development, or indirectly appropriate through such things as tax incentives, which, in essence, is an indirect appropriation from the Government to private industry to develop the alternative fuels.

Do you have any particular guidance for us from your perspective as the Lieutenant Governor?

Mr. MIXSON. Congressman, I hope that you will continue to consider it a good investment to provide some direct incentives, using the trust fund that you have got in the excess oil taxes, whatever it is, because you know what kind of excitement grew around the prospect for converting biomass into alcohol for fuel just 2 or 3 years ago.

Of course, there were dozens, hundreds of companies, trying to get a little bit of the Federal research effort so it would become economical for them to do that. Now, they have spent a lot of money.

There is an operation less than 20 miles from right here where a machine is being moved on site, as I understand, that will do just that, and with the growing efficiencies, they are going to be able to produce alcohol.

One of the biggest suppliers of alcohol for—we don't call it gasohol anymore. Nobody is going to buy gasoline that sounds like it has got whiskey in it or something. They don't call it gasohol anymore. What do they call it? It is reinforced high-test fuel. It is more efficient. It burns cooler. It burns antiknock. You don't have to use lead. Gasoline is better if 10 percent of it is an alcohol derived from grain or these sources.

Whether or not we are able to survive, when we pass the sales tax increase and some taxes on some energy sources of fuel—not sales tax, but the fuel tax just a few weeks ago. The proponents of the manufacture of alcohol from grain say that 2 or 3 or 4 cents

tax could be the difference in whether we stay economical in Florida or not, that we produce any in Florida. Do we get the machinery shipped in that is already ordered or do we cancel the order? It is that kind of touch-and-go situation with energy, with petroleum prices coming down.

If it is really that close, then obviously it would be in the best interest of the people in Florida and of the Nation if you maintain that commitment to the kinds of support for that kind of research and also consider tax advantages that we in the States make our proportionate contribution, which we did in that bill that was passed the other day, so that a few cents margin can stay there.

It saves us at least 10 percent of the total cost of imported petroleum. It makes all of our petroleum products better for us, and it is a significant contribution to the economy of our Nation. Right now, agriculture can supply an awful lot of grain without denying anybody any food, the way I see it.

Mr. NELSON. I know that yours and the Governor's administration has pushed a good bit of alternative energy sources.

Now, have you seen from your level of your State alternative fuel sources, have you seen the cooperation with the Federal research and development programs? Do you have the cross-pollenization there with the Federal Government, and, if not, how could we improve?

Mr. MIXSON. I think that the commitment has been there, and unfortunately there are signs that you have alluded to earlier that, you know, let's resume business as usual because our problem with energy has been solved. But it hasn't been solved, and we, through cooperation with you, have built a good record.

Somebody is going to testify here—Vicki, it won't be you; I don't know who is going to—and give you some quantifiable figures on just how much conservation we have achieved in Florida. I gave a little of it a while ago and some of it is in my testimony otherwise.

It is no time to quit, Congressman. It is time to continue to commit ourselves to becoming energy independent, because as I understand it, we aren't going to—we have got a lot of gas that we can get, but not fuel, petroleum products in this country. We will be able to supply less and less of our total, percentagewise. We are going to be dependent on the OPEC nations of the world, or we are going to become energy sufficient ourselves.

Right now it is not competitively feasible without a little bit of help from the Federal Government and the State government and local governments, and I hope that you all will maintain your commitment. I hope that we don't forget the dividends that we have already enjoyed and the potential dividends in the future.

Mr. NELSON. I would like to underscore, Mr. Chairman, that comment.

My chairman, Don Fuqua, has heard me say this many times, but we had a warning in this Nation in 1973 in the boycott of the oil coming from the Persian Gulf region, and then when that crisis was over, we went back to sleep. We were rudely awakened again in the spring of 1979, in all the events and turmoil that surrounded Iran, and this Nation is beginning to go back to sleep again. There were a series of four presidents who tried to tell this country that in fact we had an energy crisis, and the people wouldn't listen.

Now, the message started getting through in 1979, and we started changing our habits. We started a wholesale research and development program as an alternative to imported oil, and yet there are signs out there that we are slipping back into the same old ruts that we have been in before.

So I am delighted to hear your strong statement on behalf of the research and development, and particularly as it applies to the rural parts that have limited accessibility in this country to energy sources and particularly as it applies to our State, which is so overly dependent on imported oil in this State.

I think energy independence is the absolute essential factor in the defense and economic vitality of this country in the future.

I thank you for your testimony, Governor.

Mr. MIXSON. Our Congressman from Wisconsin talks about how much heat and all you have to have, and you do have that much more heating oil, but we are a highly energy dependent state because we have to cool an awful lot.

The quality of life in this state has greatly improved since we had the ability to turn the fans on or some air conditioning, and so forth. But more than that, since we host almost 40 million people that come to Florida every year, which is a $21 billion industry and the biggest industry in our State still, the availability and the perception that they can get energy at a price that they can afford to drive to Florida, the gasoline and the fuel business is, what we are hanging on.

Two times now, in 1974 and in 1979, when it was feared we couldn't have enough, you couldn't buy gasoline in Florida, it wrought devastating effects on our economy in a short time.

Mr. NELSON. Thank you, Mr. Chairman.

Mr. FUQUA. Governor, just a postscript to what Congressman Nelson said. Let me also say amen to that.

I have introduced with many other cosponsors of the extension of the solar tax credits that are scheduled to expire in 1985. I think it is very important, even more particularly now that we have depressed oil prices, and there is indication that that is beginning to change, but it has been very damaging to the development of alternative energies, because price comparison is not as good as it was or favorable prior to the time of the oil glut and the depression of oil prices.

As that changes—and as sure as we are sitting here that is going to change; when is a matter of debate and conjecture, but it is going to change—then these alternative sources will become even more important.

I think it behooves us now not to sit back and wait until that happens but to continue our efforts in an orderly fashion. We started on a more serious vein in the late part of the 1970's.

Mr. MIXSON. We are fortunate indeed to be sitting in the presence of a group of people—and if you will notice, the Republicans are growing on us here to be the people who can do the most about this.

Mr. FUQUA. Well, I was going to present our colleague, Tom Lewis, from down in the Fort Lauderdale area.

Tom is a new member of Congress, having served a very distinguished career in the Florida Legislature as a member of the State

Senate, and we are delighted to have him on our committee. He has made a great contribution to our committee and its deliberations.

Tom, we are very happy to have you up in the northern part of Florida, where you spent a lot of time, not in Marianna, but in Tallahassee, during your service in the State legislature. Tom, we are very happy to have you here.

Mr. LEWIS. Thank you very much.

Mr. FUQUA. Do you have any questions?

Mr. LEWIS. I would like to make a statement, if I could, Mr. Chairman. I was going to wait.

Mr. MIXSON. I didn't want to say, but he and I were in his home county on a panel on Monday morning, and Tom Lewis—I was kidding him here—served with us in the House a long time in Florida. He and his wife Miriam are some of our very closest friends in the legislature for years.

Mr. FUQUA. Well, thank you very much, Governor. We appreciate your contribution today.

Mr. MIXSON. Thank you very much. Thank you all for being here.

Mr. LEWIS. Mr. Chairman, I just wanted to apologize first. It took me a little longer to get here from Tallahassee than I thought it would. I thought I was going to come the fast way.

Mr. FUQUA. Come across bumpy I-10?

Mr. LEWIS. Bumpy I-10, yes. But we understand what those interstate problems are like. Also, in the south end, we have a portion of I-95 that is very bumpy that is not even completed at this point.

But I do want to say that I want to express my appreciation to the citizens of Marijuana—Marianna.

Mr. LEWIS. Incidentally, that is an excellent biomass we could look at for another alternative source of energy.

I want to express my appreciation to Marianna, to the conference participants for their warm hospitality. I was in Marianna several years ago on a hearing as a member of the Florida legislature, and I am pleased to have this opportunity to be with you all today.

A large part of my own congressional district is very similar to this rural area which surrounds Marianna. This energy issue strikes close to the heart of many of the people that I represent in the U.S. Congress.

I want to associate myself with remarks made by the gentleman from Wisconsin, Mr. Chairman, earlier, because I have known you for a number of years and have had the highest regard for Congressman Fuqua as an individual, and now as a colleague.

I did not have the opportunity to serve with him in the Florida legislature. His wise and judicious manner makes him an extremely effective chairman, and he is also a chairman of the only committee in Congress with the sole responsibility for the scientific research and development of programs funded by the Federal Government. He is certainly a fine mentor, and I am learning a lot from him.

I must say this, that when I went into Congress and I was very much concerned as to how the effect would be from a partisan

viewpoint, and I must say this, Mr. Chairman, you are by far the most bipartisan individual I have come across.

Any time that I have a question to ask or a statement to make, the chairman is always very gracious. It doesn't make any difference whether you are from the majority side or the minority side. But what I think is more important, you have the interests of Florida and our district at heart, and also this nation, and it is very obvious with the respect and high esteem that you are held in Congress. I am very pleased to be associated with you.

Mr. FUQUA. Thank you very much, Tom.

We will begin now with our first panel, if they will please come forward. Mr. Thomas Thayer, who is from the Governor's Energy Office; Ms. Victoria Tschinkel, who is secretary of the Department of Environmental Regulation; Dr. Charles Kidd, who is dean of the College of Engineering, Science and Technology and Agriculture at Florida A&M University.

STATEMENTS OF THOMAS THAYER, GOVERNOR'S ENERGY OFFICE; VICTORIA TSCHINKEL, SECRETARY OF THE DEPARTMENT OF ENVIRONMENTAL REGULATION AND DR. CHARLES KIDD, DEAN OF THE COLLEGE OF ENGINEERING, SCIENCE AND TECHNOLOGY AND AGRICULTURE AT FLORIDA A&M UNIVERSITY

Mr. FUQUA. We will hear from Mr. Thayer and Ms. Tschinkel and Dr. Kidd, and then we will have questions at the conclusion.

Tom, you and Jim, I didn't mean to stop you from saying all those nice things. If you want to continue doing that, please feel free to go ahead.

Mr. LEWIS. I could go on another 4 hours, Mr. Chairman, about you, but I think it is time we get on with the hearing.

Mr. FUQUA. Mr. Thayer, we would be pleased to hear from you.

Mr. THAYER. Thank you, Mr. Chairman.

My name is Tom Thayer, and the topic I will address today is Florida's existing conservation programs.

As the energy extension service coordinator with the Governor's energy office, I am pleased to be able to provide an overview of Florida's initiatives and efforts to effect energy conservation in Florida.

You know, when you talk about conservation people seem to think that that involves some kind of hurting or sacrifice. The sacrifice that we are asking the people of Florida to make is to sacrifice their waste.

We have had a long time to develop some wasteful habits. It is going to take a few years to break these habits. But the programs that Florida has initiated should bring us into the new age of energy.

The petroleum supply disruptions which we experienced in the mid-1970's dramatically demonstrated our extreme dependence on imported petroleum products. I foretold of the potentially devastating impact which a prolonged disruption could have on our economic base and our life styles—the rapid escalation of energy costs, the long lines at the gas pump, the shortages of energy-intensive

supplies such as fertilizers—all made the citizens of Florida feel as if they were being held hostage.

As in the recent diplomatic hostage situation, we initially reacted with a shock, which has grown into a fervent desire to, again take control of our destiny.

Floridians are very lucky. We have a beautiful place to live. We have tremendous representation at the State and Federal level. And we are going to take control of our lives. With strong and foresighted leadership provided by Governor Graham and Lieutenant Governor Mixson, and with the support from the legislature, programs have been initiated to bring Florida into this new age of energy—an age where our ingenuity and our technology will reduce our vulnerability, preserve our environment, and stimulate our economy.

This new age requires a keen awareness, an awareness of the need to continually strive for reduced energy inefficiency in all economic sectors, even when prices temporarily decline, as we are seeing today. Awareness is the key. We don't want to have a shortsighted memory. We must remember what happened in the mid-1970's and the late 1970's.

The overall theme for Florida's public awareness campaign is "Save It, Florida." This highly successful program is an example of government and private industry working together to effect energy efficiency.

The expenditure of approximately $300,000 in federally provided funds has been matched by $10 million in private donations over the last 4 years. $300,000 to $10 million is a very good cost-to-benefit ratio.

An example of our public service advertisements would be our phase 1 tanker spots. If you can imagine as a camera moves in on a petroleum tanker, looming on the horizon, the narrator ominously stresses Florida's dependency on imported petroleum products.

It highlights the need to save energy resources for the continued well being of our country, our State, ourselves, and for our future generations. It typifies energy waste as not only hurting our side, but actually helping their side.

We are currently in our fifth phase of this awareness campaign, and our most recent star was Steve Garvey.

We hope that you have seen our awareness campaign which stresses how to "Save it on the road," "Save it at work," and "Save it at home."

This new age of energy requires extensive educational programs to provide proper information to all Floridians. Only by providing all consumers with access to state-of-the-art information can we insure that energy decisions are made by an informed public and thereby stimulate free market activity.

Florida is promoting education and the public dissemination of information on energy and its economic, environmental and social impacts in a variety of ways. Energy has been integrated into the traditional elementary, secondary and post-secondary educational process by the department of education. The early success of this education effort was readily apparent when reviewing the student energy science fair projects which were on display earlier this week.

Our universities and community colleges are playing a major role in Florida's overall energy program. These institutions are expanding their technical course selections, providing community outreach, such as this conference today, and intensifying research and development in energy-related areas.

The Florida Solar Energy Center is nationally recognized as a leader in solar energy research and development. The center not only conducts highly technical research into active and passive solar systems, but also conducts extensive educational information services.

The Institute of Food and Agricultural Sciences of the University of Florida has a long record of providing technology transfer to rural audiences, and energy is no exception.

The IFAS energy programs include educational outreach and technical assistance as well as research and development into low-energy technologies and renewable resources.

The cooperative extension service has established each office as a county energy information center, so that we can provide state-of-the-art information to residents in each of our 67 counties.

The cooperative network also delivers the energy extension service, under contract to the Governor's energy office, which provides specific commercial audiences with state-of-the-art conservation measures.

We have developed Florida specific energy education and reference manuals for a wide number of our economic sectors. We have manuals for agriculture, hotel/motel, builders, realtors, small business, financial institutions, trucking, transportation planners, waste water operators, and on and on.

We have developed fact sheets and technical materials and have disseminated these to the public, utilizing non-profit organizations, private corporations, and anyone else interested in helping us get the word out on energy conservation.

In fact, we have even developed information on energy efficient clothing entitled "What Do You Wear to an Energy Crisis," so that in case we ever have a prolonged disruption we are going to be the most appropriately dressed state in the country.

New information is constantly being generated in response to consumer inquiries or due to our technical advances.

The final element required to bring Florida into this new age of energy is action, and Florida has taken action.

The Florida Energy Efficiency and Conservation Act, which was discussed by Lieutenant Governor Mixson, is a prime example of how we can utilize our utilities to provide information to the general public. Florida Power & Light has a very aggressive conservation program as does Gulf Power with its good cents program, Florida public utilities has been instrumental in supporting this conference.

Our utilities are responding. They have set goals and they are delivering programs. Oftentimes people disbelieve utilities, when they come in and say, "Next month, we want you to send us $20 less; we want you to implement these operating and maintenance recommendations, so that you can keep your money," they simply cannot believe that. But if you will look at the large utilities on the New York Stock Exchange, every time they announce they are

going to build another generating plant, watch the price of their stock drop. Their investors don't want them building more plants. They would prefer that they go out and implement conservation efforts.

Some of the examples of innovative conservation programs would include the city of Tallahassee's zero interest loan program. An energy audit is conducted, retrofit recommendations are made, and then access to zero interest capital is provided and debt service is included in your utility bill. That is what it is going to take in these times of high interest rates.

It is very difficult for the typical citizen to go out and borrow money at 18 percent to implement conservation measures. Even when the payback period is considered to be very advantageous, you must consider the cash flow impact. So the city of Tallahassee program, which provides this capital, is a very interesting one, and we hope that it will serve as a pilot to be implemented in other communities.

The model energy efficiency code for building construction is administered by the Department of Community Affairs, and was enacted to improve the thermal efficiency of new buildings as well as substantially renovated buildings.

The Florida energy research and development task force has been enpaneled to prioritize research activities and facilities, and to assist us in identifying where we need to place our research dollars.

The Solar Energy Standards Act provided for the establishment of standards in testings and certification by the Florida Solar Energy Center as it relates to solar collectors.

The State also provides incentives for solar. We do not apply sales tax to the purchase of solar equipment in the State of Florida. Solar installations in residences are also excluded from property tax assessments.

Numerous State agencies have incorporated energy activities into their existing operations. The State of Florida chose not to go out and develop an expansive new bureaucracy to administer our energy conservation programs. We have incorporated energy conservation into our ongoing functions, and have tied into existing networks such as the cooperative extension service to deliver services and information.

The Governor's energy office is primarily responsible for the coordination and monitoring of all energy activities, the collection of data, and for the administration of federal programs such as the State energy conservation plan, the energy extension service, and the institutional building grants program, which is more commonly referred to as the schools and hospitals program.

The GEO and the PSC have also developed an energy emergency contingency plan directed at mitigating the potential adverse economic and social impacts which a prolonged interruption in petroleum supplies would have on this State. So to the commercial sector, we can say that Florida is prepared. In case we have a severe interruption, we will insure that commerce will have the energy that it takes to continue our economic activity.

The department of general services administers the State energy management plan and is responsible for monitoring energy con-

sumption in existing State facilities. Also the Florida life cycle energy efficiency technique, which is a computer analysis, is performed on all new buildings to insure that building design and mechanical configurations are optimized for energy conservation.

The department of transportation has included energy into its planning and is actively pursuing programs in ride sharing, traffic light synchronization, bike paths, and asphalt recycling.

The department of community affairs, in addition to administering the model energy efficiency building code, also delivers our weatherization program which provides services directly to low income and indigent individuals in the form of weatherizing and insulation.

The department of health and rehabilitative services administers the low-income energy assistance program which provides financial assistance to partially defray the energy costs of low-income families.

Even the department of law enforcement and the Florida Highway Patrol have incorporated energy conservation into its existing training program. So when you see State troopers traveling up and down our highway system, you will know that they are driving with conservation in mind.

In fact, all of our State agencies have conducted employee training programs and have developed their own conservation plans, so that government can lead by example.

Local governments have also taken action to effect energy efficiency. Many municipalities have retained energy coordinators and even more have adopted an energy element into their comprehensive planning programs.

Zoning ordinances which inhibit the efficient use of energy are being revised and replaced. A few local governments have even prohibited or penalized the use of energy inefficient appliances, most notably electric strip heating.

To date, Florida's programs for energy independence have been very successful. We have reduced our dependency on imported petroleum products in the last few years by more than 10 percent. The residential and commercial sectors are gaining confidence in alternate energy technologies.

The tremendous potential which renewables embody, particularly biomass and solar, is being recognized, accepted, and incorporated into our lives. In fact, if you want to look at an example of how well our programs are working, the 4E conference would be my primary example. Government cannot do everything, the people must respond.

This conference is truly a grass roots efforts. Volunteers have been working on this project for 2 years, so obviously the people of northwest Florida are aware of the potential to do better. They are heeding our educational programs. They are seeking advice through this congressional hearing and through the symposium and the other projects here, so that they can go out and make informed decisions.

Although much has been done, much remains to do. We must continue with our awareness activities, and our educational outreach programs.

Additional technical assistance will be required, due to the somewhat foreign and even exotic nature of some of the renewable systems that we are promoting. Research and development must continue in the area of renewable energy resources and systems.

I must confess that we are a little concerned about the seemingly mixed signals concerning energy which occasionally come out of Washington. As the Energy Extension Service coordinator, I can tell you that it is no fun to be zeroed out in the budget every year. We hope that political rhetoric is not weakening our resolve or shortening our memory.

Truly, energy programs are in the national interest and should receive deliberate and favorable consideration by the administration and the Congress during the appropriation process.

In conclusion, I would like to say that the State of Florida is definitely aware of its opportunities for increased energy efficiency, utilizing conventional energy sources and of the tremendous potential which renewable resources hold for Florida.

We are educating our citizens so they can make informed decisions, and we are taking action in every economic sector to safeguard existing employment and to promote additional employment opportunities.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Thayer follows:]

Testimony for

Subcommittee on Energy Development and Applications of the
Science and Technology Committee

Field Hearing: "Rural Economic Development and Energy: What is Needed, What is Being Done"
Chipola Junior College
Marianna, Florida
April 15, 1983

My name is Tom Thayer and the topic which I will address today is Florida's existing conservation programs. As the Energy Extension Service Coordinator with the Governor's Energy Office, I am pleased to present an overview of Florida's conservation efforts and initiatives.

The petroleum supply disruptions experienced in the mid 70's dramatically demonstrated Florida's extreme dependency on imported oil. It foretold of the potentially devastating impact which a prolonged disruption could have on Florida's economic base and the lifestyle of its residents. The rapid escalation of energy costs, long lines at the gas pumps, and shortages of energy intensive supplies all combined to make the citizens of Florida feel as if they were being held hostage. Floridians reacted to this situation with an initial shock which has developed into a furvent resolve to again take control of our future.

With strong and foresighted leadership provided by Florida's chief executives, Governor Graham and Lt. Governor Mixson, and with support from the legislature, programs have been initiated to bring Florida into a new age of energy--an age where ingenuity and technology will reduce our vulnerability, preserve our environment and stimulate our economy. This new age requires

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a keen awareness--an awareness of the need to continually strive for reduced energy inefficiency in all economic sectors, even when prices temporarily decline.

The overall theme for Florida's public awareness campaign is "Save It, Florida." This highly successful program is an example of government and private industry joining forces to combat energy inefficiency. The expenditure of $300,000 public dollars to create and develop the campaign has resulted in over $10,000,000 of awareness advertising provided by 83 private groups and corporations working as the Governor's Energy Partners. An example of the Public Service Advertisements broadcast under this program would be our phase I tanker spots. As the camera loomes in on a petroleum tanker on the horizon, the narrator ominously stresses Florida's dependency on petroleum products imported from unstable environments. It highlights the need to save energy resources for continued well being of our country, our state and for ourselves and future generations. It typifies energy waste as not only hurting our side, but actually helping their side. Our phase four ads dealing with the topics of air conditioning and hot water heating featured Steve Garvey and drew rave reviews from our female audience. We are currently in the fifth phase of this statewide awareness program which provides consumers with awareness information on how to "Save It-on The Road," "Save It-at Work," and "Save It-at Home."

The new age of energy requires extensive educational programs to provide proper information to all Floridians. By providing all consumers with access to state-of-the-art information, we can insure that energy decisions are made by an informed public and thereby stimulate free market activitiy.

Florida is promoting education and the public dissemination of information on energy and its economic, environmental, and social impacts in a variety of ways. Energy has been integrated into the traditional elementary, secondary, and post secondary instructional process by the Florida Department of Education. The success of this educational effort was apparent when viewing the excellent student energy science projects on display earlier this week.

Universities and community colleges are playing a major role in Florida's overall energy program. These institutions are expanding technical course selections, providing community outreach education, and intensifying research and development in energy related areas.

The Florida Solar Energy Center is recognized nationally as a leader in solar energy research and development. The Center not only conducts highly technical research into active and passive solar systems, but also offers educational and information services.

The Institute of Food and Agricultural Sciences (IFAS), of the University of Florida, has a long record of providing technology transfer services to rural audiences and energy is no exception. The IFAS energy programs include educational outreach and technical assistance as well as research and development of low energy technology and renewable resources. Cooperative Extension Service offices have been established as County Energy Information Centers and energy has been incorporated into existing cooperative programs. The cooperative network also delivers Energy Extension Service (EES) programs to specific commercial audiences under contract to the Governor's Energy Office.

Florida specific energy education and reference manuals have been developed for agriculture, hotels/motels, builders/realtors, small business, financial institutions, trucking and fleet operations, transportation planners, water/wastewater operations, school administrators, and local government.

Fact sheets and technical materials have been disseminated by public, private, and non-profit organizations on topics such as photovoltaics, solar water heating, passive solar, lighting, appliances, heat recovery, cogeneration, and even information on energy efficient clothing entitled "What do you Wear to an Energy Crisis". And new information is constantly being generated in response to consumer inquiries or due to technical advances.

The final element required to bring Florida into the new age of energy is action. Action has been taken to increase energy efficiency. The Florida Energy Efficiency and Conservation Act required the Public Service Commission to adopt by rule energy conservation goals and objectives to be implemented by utilities. Examples of innovative conservation programs initiated by utilities include the City of Tallahassee zero-interest loan program which provides consumers with the capital so that energy audit recommendations can be implemented and the Gulf Power "Good Cents" program which provides information, technical assistance and rebates to residential and commercial consumers.

The Model Energy Efficiency Code for Building Construction was enacted and is administered by the Department of Community Affairs to insure thermal efficiency in new and substantially rehabilitated buildings. The Florida Energy Research and Development Task Force was createdto coordinate

research activities and facilities and prioritize research needs. The Solar Energy Standards Act provided for the establishment of standards and testing and certification by the Florida Solar Energy Center. The state also has an excellent solar contractor certification program operated by the construction industry licensing board. Additionally, solar incentives were enacted which exempt systems from sales and property taxes.

Numerous state agencies have incorporated energy activities into their operations. The Governor's Energy Office (GEO) is responsible for the coordination and monitoring of energy activities, collection of data and for the administration of the State Energy Conservation Plan, the Energy Extension Service, and the Institutional Building Grants Program. The GEO and PSC have developed an Energy Emergency Contingency Plan directed at mitigating the potential advance economic and social impacts of an interruption in petroleum supplies.

The Department of General Services (DGS) administers the state energy management plan and is responsible for monitoring energy consumption in existing state facilities. New state facility designs are analyzed utilitizing the Florida Lifecycle Energy Efficient Technique to determine optimum efficiency. DGS also is installing an energy management system to control energy utilization in the Capitol complex and conducts preventive maintenance workshops for maintenance staff.

The Department of Transportation has included energy into its planning process and is actively pursuing programs in ridesharing, traffic light synchronization, bike paths, and asphalt recycling.

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In addition to the Model Energy Efficiency Building Code, the Department of Community Affairs administers the Weatherization program, which provides services directly to indigent and low-income individuals in the form of caulking, weatherizing and insulation.

The Department of Health and Rehabilitative Services administers the low income energy assistance program, which provides financial assistance to partially defray the energy costs of low-income families.

The Florida Department of Law Enforcement has incorporated Driver Energy Conservation Awareness Training into its training program as has the Highway Patrol.

In fact all state agencies have conducted employee training programs and developed their own conservation plans so that governments can lead by example.

Local governments have also taken action for energy efficiency. Many municipalities have retained energy coordinators and even more have adopted an energy element in their comprehensive plan. Zoning ordinances which inhibit the efficient use of energy are being replaced. A few local governments have even prohibited or penalized energy inefficiency in new construction, most notably electric strip heating.

To date, Florida's program for energy independence has been successful. We have reduced our dependency on imported oil by more that 10% over the last few years. The residential and commercial sectors are gaining confidence

in alternate energy technology. The tremendous potential which renewables embody, particularily bio-mass and solar, is being recognized and accepted.

In fact I can think of no finer example of how citizens of Florida are reacting to our energy situation than the 4E Conference. The people of Northwest Florida are obviously aware of the situation and seeking information upon which to base their actions. We hope that this community developed conference is only the first of many more to be conducted in other parts of the state.

Although much has been done, much remains to do. We must continue our awareness activities and our educational outreach. Additional technical assistance will be necessary due to the foreign and somewhat exotic nature of renewable energy systems. Research and development must continue in the area of renewable energy resources and systems.

We are concerned about the seemingly mixed signals concerning energy which come out of Washington. We hope that political rhetoric is not weakening our resolve or shortening our memory. Energy programs are in the national interest and should receive deliberate and favorable consideration by the administration and the congress during the appropriation process.

In conclusion, the State of Florida is aware of the opportunities which exist for increased energy efficiency using conventional energy sources and of the potential which renewable energy resources hold for Florida's future. We are educating our citizens so that they can make informed decisions regarding energy consumption. We are taking action in every economic sector to safeguard existing employment and to promote additional employment opportunities.

MR. C. THOMAS THAYER
1515-66 Paul Russell Road
Tallahassee, Florida 32301

Place of Birth: Newport, Rhode Island
Date of Birth: June 21, 1953

Home Phone: 878-2348
Office Phone: 488-6764

Professional Talents

Skilled in state government administration; experienced in contracts solicitation, negotiation and award; experienced in promulgating policies and procedures to effect internal control and economy, efficiency and effectiveness in operations; financial and compliance expertise; program planning, development and delivery experience; organization and decision making abilities.

Educational Experiences

Undergraduate: Gulf Coast Community College, AA, 1973
Panama City, Florida
Major: Chemistry

Florida State University, BS, 1975
Tallahassee, Florida
Major: Finance

Continuing Education: AICPA Courses

Employment History

Governmental Analyst III (11/82-present): Governor's Energy Office
Governmental Analyst II (11/79-10/82) Tallahassee, Florida

Duties and Responsibilities

- General Office Administration
- Internal Auditor
- Contracts Officer
- Energy Extension Service Coordinator
- Productivity Coordinator
- Personnel Liaison
- Grants Monitoring

Internal Auditor II (10/79-11/79)
Internal Auditor I (10/78-10/79)
Department of Corrections
Tallahassee, Florida

Duties and Responsibilities

- Financial and Compliance Audits
- Economy, Efficiency and Effectiveness Audits
- Policy and Procedure Development and Implementation
- Systems Analysis
- Supervise Junior Auditors

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Property Manager III (5/77 - 10/78): Department of Corrections
Property Manager II (3/76-5/77) Tallahassee, Florida

Duties and Responsibilities

- Supervise Property Clerks
- Establish EDP Property Control System
- Leasing Officer
- Surplus Property Coordinator
- Records Management Officer
- Supervise Printing Operations

Professional Organizations and Honors:

- Elections Commissioner, Florida State University, 1975
- Member Tallahassee Institute of Internal Auditors

Mr. FUQUA. Thank you very much, Mr. Thayer.

Next will be Ms. Tschinkel. I notice you have a lot of charts. If you wish, we will make your statement a part of the record in its entirety, and if you wish to summarize, we would be delighted.

We do have a number of more witnesses. We hope to conclude before dinner this evening, but we will make your statement part of the record if you wish to summarize—and likewise, Dr. Kidd.

Ms. TSCHINKEL. I have about eight points I would like to make. I will touch on those and not elaborate too much.

I just want to thank you, Mr. Chairman, for the courtesy your committee extended to me recently in Washington, having been raked over the coals from time to time by congressional committees who have a lot of questions to ask, and sometimes in a very excited manner, I found it a very intelligent operation and appreciated the courtesy.

As you know, in addition to my responsibilities as Secretary of the Department of Environmental Regulation, which is the principal pollution control agency in this State, since 1978 I have had the privilege to serve on the Federal Energy Research Advisory Board, which is the principal research advisory body to the Secretary of Energy in Washington.

The Energy Research Advisory Board published a biomass report in 1981, and in addition, I chaired a solar panel which looked at several areas of renewable energy and that Panel's report just came out last fall. We looked at photochemistry and basic research, photovoltaics, solar thermal, wind, OTEC, biomass, and solar building applications.

I would like to make several points about rural energy and economic development. Those are the eight points that I mentioned to you that I think are pretty important.

First of all, I think that we probably all agree that the current oil situation is transitory, and that rural America is actually far more dependent on petroleum distribution than almost any other sector of the economy.

In fact, about 82 percent of the energy in rural America is petroleum derived, so we are extremely vulnerable. ERAB is particularly concerned about the false security that seems to have been created and is going to disappear.

Second, despite the oil surplus and despite the economic recession, renewable energy technologies are continuing a slow but steady growth, and that is very interesting.

We have found that this is particularly true of biomass energy, which now provides 2 percent of the total energy supply in the United States.

But there is also growth occurring right now in small wind machines, domestic solar water heating, passive solar design and industrial solar thermal uses.

This pattern of continuing dependence on renewable energy is particularly visible in Florida. In fact, we saw that renewable energy use in Florida grew by 6.5 percent between 1980 and 1981 and now accounts for 5.3 percent of our total energy consumption in Florida. I think the most interesting thing to note is that puts us ahead of the total energy supply in Florida from nuclear power, so that is an interesting thing to keep in mind as well.

The third point is that the rural areas are really at a disadvantage in use of conventional energy sources, but are very well suited for many renewable energy sources.

Of course, the reason that the rural areas are so vulnerable to conventional energy growth problems is because of the low density, and the disperse nature of rural development.

Obviously, in rural areas, we are all highly dependent on private passenger cars and there is probably no major hope in the future for getting on more mass transit systems.

In addition, electric rates are frequently higher in rural areas, and we don't have some options for clustered residential development and high density development that we have in the cities.

However, there are some things that give hope for renewable energy source that we need to look at.

First of all, the high conventional costs that I mentioned means that renewable energy are much more likely to find uses in rural areas first. Small wind machines and even photovoltaic cells now are actually competitive in some rural areas.

Second, the rural areas can benefit from the requirements of decentralized development of a lot of operations in renewable sources.

For example, the fuel characteristics are widely dispersed, the handling requirements of renewables often require large amounts of land. A low head hydroproject may mean absolutely nothing to a large city, but might make or break a small industrial project or a small rural energy need.

Third, of course, there are readily available biomass feedstocks in rural areas.

Fourth, there is an existing strong technology base in support of biomass energy in rural areas, because of the parent agriculture base. People that are not knowledgeable in the operation of agricultural activities can turn their attention to biomass in the most intelligent manner.

Five, we have land costs, our big advantage in rural areas. And, unfortunately, renewable energy, not just biomass but most of the renewable energies—are extremely land dependent, and for that reason often can't be afforded in the cities.

And, finally, it is a well-known factor that those of us who live in cities have become highly dependent on one another, whereas in

the rural areas there is a tradition of self-reliance and individual competency in many areas, broad areas that are needed for good use of renewable energy.

The fourth point I want to make is that biomass is an especially significant renewable energy source for rural economic development, particularly in a State like Florida. We found that with appropriate research and development, on a national basis, biomass has a potential to supply the Nation with about 5 percent of the projected U.S. energy consumption by the year 2000. That would be about five quads.

That is considered an extremely conservative estimate, by the way, with the Office of Technology Assessment making quite a more significant estimate. In fact, 50 percent of Florida is covered by forests, and the other Southeastern States also have significant forest cover.

In north Florida, here, we have a percentage of Florida forest cover of about 75 percent. Most of the studies that we have seen show that these forest resources are underutilized and could be broadly expanded for biomass energy even when considering important environmental safeguards, which I will go into briefly in a moment.

There is an institutional problem, though, and that is item five. In examining the biomass program on a national basis, we found that it needs refocusing and that it needs continual Federal R&D support.

This is an area where there is a host of agencies that are involved in biomass development, and yet we don't have a national biomass plan that allows us to focus all the different programs in support of biomass development.

The principal area for research we think that is highly significant is the need to understand and expand the resource base itself. We need to help people with resource assessments and to identify available wastes that are not presently being used. So people will know what needs to be used, we need to conduct basic research in photosynthesis, genetic engineering and so forth that we can improve the resource base.

There is a lot of misunderstanding about plants themselves and we need to help pick out the best plants that are going to be useful for biomass. There are also some conversion R&D issues that need to be looked at.

Biological and thermochemical conversion processes need to be looked at more carefully, and we need to have a look at the possibility of developing chemical feedstocks from biomass, not just burning them directly for energy use. Because if we can back out petroleum as chemical feedstocks, that will help us use petroleum for things for which there are no substitutes.

The sixth point I need to make is that there are some significant environmental problems associated with biomass development, and those need to be continued to be researched, because they could be a make-or-break issue over the long run. Nevertheless, biomass also offers opportunities to improve the environment in some areas, and so that is an interesting balance that needs to be looked at.

The obvious issues, potential depletion of soil and nutrients, the possibility for increased erosion, and decrease of water quality and fish and wildlife habitat. Also, what is becoming more and more apparent, for those of us heat our houses with wood stoves as I do, is that we are creating some air pollution problems that could be significant and are not well understood in many cases.

Two particular problems related to biomass production are of concern in Florida, as we have examined it. The increased emphasis on the use of wetlands for biomass production, is of concern. In Florida, we look to our wetlands for water storage, filtration capacity, and important wildlife habitat.

The second problem is that Florida already has many runaway exotics and we don't want to encourage any more in the State. So we need to keep an eye on that.

Finally, of course, there is the food versus fuel controversy, which I can't add anything to much personally at the moment, but this is something clearly that, if there is going to be a massive increase in biomass use, we need to keep our eye on.

But there are some pluses we are all well aware of for biomass energy use, particularly in conversion of waste. There are cost, problems and the ability to maintain methane operations at feedlot facilities is somewhat dependent on the number of animals. There are some ups and downs with them in the current economy. With entrophication problems, or in Lake Okeechobee where we are facing 35,000 dairy cattle discharging directly into that important water supply system. We are not just looking at an energy problem, but also a disposal problem for biomass.

In addition, of course, with our concerns about acid rain and CO^2 build-up, biomass offers us an opportunity for energy generation that might help to avoid some of these problems.

The seventh point I would like to make is that there are other energy renewable sources that we need to keep an eye on for rural America. They do deserve further research and should not be put aside, and these of course include low-head hydro, domestic solar hot water heaters, which are very usable everywhere in Florida, passive space heating, cooling for dwellings, and livestock buildings and solar crop drying.

In fact, ERAB found that the small wind turbine industry is now selling approximately 1,500 machines per year in the United States. Of course, we realize Florida is probably not standing in line for wind source in most cases.

However, solar hot water heaters are going to be very much used, and we figure that there were about 40,000 units in use in Florida, and then an additional 18,000 would be added in 1981. By about the year 2000, there are going to be three-quarters of a million residential solar hot water heaters in use in Florida.

If we keep an eye on the use of heating water for dairy milking parlors, greenhouse heating, powering irrigating pumps using photovoltaics or parabolic dish-Rankine engine systems, and for distilling and dehydrating, we have got some very good opportunities that should be cost effective now.

The final comment I would like to make has to do with the Federal role in support of this renewable effort for helping the rural areas. I don't think that any of us feel that the Federal Govern-

ment can back out of their research and development efforts, particularly in the biomass and other renewable areas.

The time is going to come when these are going to become more and more important for the country and we need to look to Washington for assistance in resolving these scientific questions. The States cannot afford to individually fund R&D; it is simply not possible. We need to share our information as a country.

Second, it seemed clear, very clear to our ERAB panel that we cannot abandon the solar tax credits at this point. It would be devastating to the solar industry. There are very good policy reasons, because of the petroleum back-out, but also legitimate economic reasons, such as balancing various subsidies that are given to other energy industries, to give the solar energy industry a little boost for a few more years to come.

That concludes the most important comments that I needed to make.

[The prepared statement of Ms. Tschinkel follows:]

Prepared Statement of Victoria J. Tschinkel

Mr. Chairman and Members of the Committee:

I am Victoria J. Tschinkel, Secretary of the Florida Department of Environmental Regulation. I appreciate the opportunity to appear before you today to discuss "Rural Economic Development and Energy: What is Needed, What is Being Done".

The Florida Department of Environmental Regulation is the principal regulatory agency for air and water pollution control, solid and hazardous waste, dredge and fill, drinking water and power plant siting in Florida. Thus, I am greatly interested in the environmental aspects of rural economic development and energy. I will provide some comments on this subject further on in my remarks. Also, since 1978, I have served as a member of the Energy Research Advisory Board, or ERAB, which advises the Secretary of the U.S. Department of Energy on national energy research and development priorities. In November, 1981, ERAB published a comprehensive report on "Biomass Energy", which is very pertinent to rural economic and energy development. In addition, last summer and fall I chaired an ERAB panel on solar research and development which studied the status of seven solar technology areas: photochemistry and basic research, photovoltaics, solar thermal, wind, OTEC, biomass and solar building applications. The Panel's report: "Solar Energy Research and Development: Federal and Private Sector Roles", completed in September, 1982, addressed many areas that are significant to rural energy development.

* The current oil surplus is transitory; rural America is far too dependent on disruptible petroleum supplies.

On February 6, 1980, in testimony before the Senate Committee on Energy and Natural Resources, Deputy Secretary of Agriculture Jim Williams (formerly Florida's Lieutenant Governor) pointed out the very large dependency agriculture, forestry and rural America have on petroleum based energy. This is clear from the data in Table 1, taken from his presentation.

In these days of surplus oil and falling gasoline prices, it is easy to overlook this dependency. Yet, as was emphasized in the ERAB Solar R & D Report, the current oil surplus is transitory and the U.S. continues to have a dangerous dependency on potentially interruptible foreign oil supplies. There is no doubt that fossil fuels are finite and will be exhausted in the forseeable future. The need to develop alternative energy sources is as urgent as it ever was, particularly for rural America.

* Despite the oil surplus and economic recession, renewable energy technologies are continuing a slow but steady growth.

Even with surplus oil, soft energy prices and a world economic recession, the ERAB Solar R & D Panel found that many solar technologies are continuing to slowly grow and mature. This is especially true of biomass energy

TABLE 1

ENERGY USED IN AGRICULTURE, FORESTRY, AND RURAL AMERICA, 1978

Sector	Quads	Percent is derived from petroleum resources	Percent of U.S. total
Agricultural production	2.5	93	3.2
Food processing	1.0	84	1.3
Forestry	2.7	51	3.5
Rural housing	3.1	71	4.0
Rural vehicular use	4.5	100	5.8
Total	13.8	82	17.8

SOURCE: Testimony of Jim Williams, Deputy Secretary of Agriculture, Before the U.S. Senate Committee on Agriculture, Nutrition and Forestry. February 6, 1980.

which now provides 2% of total U.S. energy consumption. However, there is also growth in small wind machines, domestic solar water heating, passive solar design and industrial solar thermal uses. This pattern of gradually increasing use of renewable energy sources is apparent in Florida. The Governor's Energy Office has recently reported that renewable energy use in Florida grew by 6.5% between 1980 and 1981 and now accounts for 5.3% of total consumption. This nearly equals the total contribution to the state's energy supply from nuclear energy. Figure 1 and Table 2 provide more details.

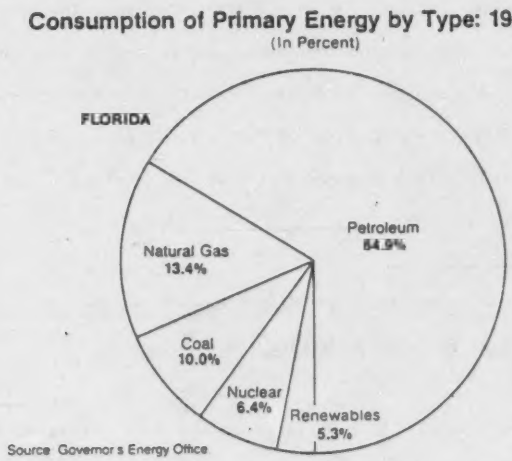
- Rural areas are at a disadvantage in the use of conventional energy sources, but are well-suited for many renewable energy sources.

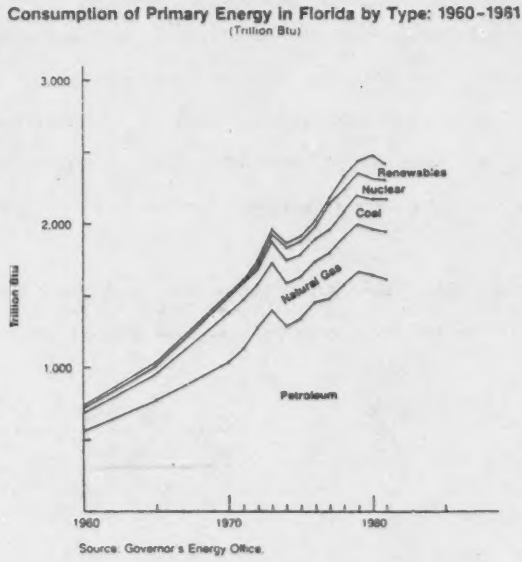
There are a number of factors which put rural areas at a disadvantage in terms of conventional energy availability and cost. The low density, and dispersed nature of rural development results in long travel distances and high transportation costs. Rural dwellers are highly dependent on private passenger cars and probably will never have the mass transit options available to them that urban residents do. In addition, electric rates are usually notably higher in rural areas. The energy conservation potential of clustered residential development (e.g., the lower energy costs of multi-residential buildings, district heating, etc.) is also usually not possible for rural dwellers.

At the same time, there are characteristics of rural areas which make them especially well-suited for renewable energy sources. Some of the factors

FIGURE 1

CONSUMPTION OF PRIMARY ENERGY IN FLORIDA BY TYPE





SOURCE: Governor's Energy Office. 1982. Florida Energy Data: 1960 - 1981.

TABLE 2

FLORIDA RENEWABLES CONSUMPTION BY SECTOR: 1960 - 1981
(Trillion BTU)

	ELECTRIC UTILITY	RESI-DENTIAL	COMMER-CIAL	INDUS-TRIAL	TRANSPOR-TATION	GOVERN-MENTAL	TOTAL
1960	2.9	0.0	0.0	0.0	0.0	0.0	2.9
1965	3.1	0.0	0.0	0.0	0.0	0.0	3.1
1970	3.0	0.0	0.0	0.0	0.0	0.0	3.0
1975	2.4	0.0	0.0	0.0	0.0	0.0	2.4
1976	2.7	0.0	0.0	0.0	0.0	0.0	2.7
1977	2.5	0.1	0.1	45.8	0.0	0.0	48.5
1978	2.3	0.2	0.1	49.3	0.0	0.0	51.9
1979	2.6	0.4	0.1	53.2	0.0	0.0	56.3
1980	2.5	1.8	0.0	113.7	0.2	1.0	119.2*
1981 (Est.)	2.7	1.9	0.0	121.1	0.2	1.0	126.9*

NOTE: - Numbers may not add due to rounding.

- *Reporting procedures for renewables were improved in 1980, accounting for the substantial increases reported in 1980 and 1981.

SOURCE: Governor's Energy Office. 1982. Florida Energy Data: 1960 -1981.

which work to the disadvantage of rural areas for conventional energy sources can favor the use of renewable energy sources:

1) High conventional energy costs: higher conventional energy costs for rural areas means that renewable energy sources become competitive with conventional fuels in rural areas before urban areas. This is already true, for example, for small wind machines for some applications. The ERAB Solar R & D Panel found as a general trend that the more remote a given energy need is, the more competitive are renewable sources. For very remote applications, such as relay towers and navigational aids, photovoltaic cells are already cost effective, bit they will not be for many years for uses which can be readily tied into the central station electrical grid.

2) Dispersed, decentralized development: many renewable energy sources will not work in large-scale, industrial or central station electrical generation situations because of fuel characteristics, handling requirements and other problems. They may be suited however, to the smaller scale, decentralized development typical of rural areas. A low-head hydro project may mean little to the energy needs of a large urban-industrial complex but can be entirely satisfactory for a small rural-based industry.

3) Readily available biomass feedstocks: most rural areas have large quantities of potential biomass feedstocks available, including not only conventional agricultural crops and wood, but also materials which are currently under utilized such as agricultural wastes and manures.

4) Existing strong technology base: the development of cost-effective biomass energy will require some modifications in existing agricultural technology which aims at food and fiber, rather than fuels production. Nevertheless, much of the technology for biomass cultivation, harvesting and pretreatment can be built upon the existing strong agricultural technology base in rural areas. In addition, many rural dwellers have considerable expertise in operating and maintaining this technology.

5. Land costs: many renewable technologies require large amounts of land. This includes not only biomass "energy plantations" but also high technology approaches such as power towers and wind farms. Once again, rural areas are favored because land costs are much lower than sites near urban areas.

6. Tradition of self-reliance: a final point which makes rural areas attractive for renewable energy development is perhaps less quantifiable than the others, but is still significant. There has always been a strong tradition in rural America of self-reliance. This tradition, which encourages the growing of one's own food and building of one's own shelter, will also help to encourage the producing of one's own renewable energy.

To summarize this point, there are many reasons why renewable energy sources are highly compatible with both the energy needs and the resources of rural America. It makes sense therefore, to target rural areas for renewable energy research, development and demonstration.

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- Biomass is an especially significant renewable energy source for rural economic development.

In both its Biomass Energy and Solar R & D reports, ERAB concluded that biomass energy already is a well established part of the Nation's energy base. Except for hydropower, biomass now provides more energy than all other renewable sources, about 1.2 quadtrillion BTU (Q) net or almost 2% of the total U.S. energy consumption (78 Q). Most of this use is by the forest products industry of biomass wastes and residues to produce process steam and some electricity. Nationwide, this industry produces about half of its energy needs from mill residues, logging residues and forest thinnings. Other biomass uses include the direct burning of wood for residential space heating, the burning of bagasse to produce heat used in sugar cane processing plants (and in some locations, such as South Florida, to produce electricity), the processing of corn into alcohol and the production of a small amount of methane from animal manures.

ERAB found that, with appropriate research and development, biomass has the potential to supply the nation with about 5 Q net or about 5% of the projected U.S. energy consumption of 100 Q by the year 2000. The ERAB projections tend to be conservative, and other studies indicate a larger potential contribution from biomass. A report by the Congressional Office of Technology Assessment, entitled "Energy from Biological Processes" (July 1, 1980) indicated that biomass could provide as much as 17 Q by the year 2000. In its Solar Energy -- Program Summary Document for FY 1981, the Department of Energy estimated that biomass could contribute 8 to 10 Q by 2000.

While biomass energy cannot provide for most of the Nation's energy needs, it can be a highly significant regional source. This seems particularly true for the Southeastern U.S., including North Florida, where there is an abundance of wood. It is estimated that 50% of Florida is covered with forests. Other southeastern states also have significant forest cover (see Figure 2). In North Florida, the percentage of forest cover is closer to 75%. Many studies have indicated that the Nation's forest resources are under utilized, even when allowances are made for environmental safeguards such as watershed protection, recycling of nutrients and providing for wildlife habitat. Figure 3 and Table 3 provide additional details on the volume of wood available in Florida on commercial lands.

* <u>The U.S. Biomass Program needs refocusing, and continued Federal R & D Support.</u>

One of the key findings of the ERAB Solar R & D Panel regarding biomass was that the national research agenda for biomass energy needs to be refocused and put into a new conceptual framework. ERAB found that:

> The biomass R&D agenda seems to be an agglomeration of ill-fitted programs, and the situation seems too amorphous to allow for effective evaluation and management. This has resulted primarily from the historical growth of biomass programs and the way these programs were created. There is

FIGURE 2

SOURCE: Florida Solar Energy Center. 1981. Proceedings of the Solar Technology Assessment Conference. Solar Technology Assessment for Biomass.

FIGURE 3

Commercial Forest Land, Growing Stock and Total Biomass by Region in Florida

Northeast Florida
Forest Land – 6,844,470 acres
Growing Stock – 170.8 million ton
Total Biomass – 513.2 million tons
Northwest Florida
Forest Land – 5,512,061 acres
Growing Stock – 127.0 million tons
Total Biomass – 388.3 million tons
Central Florida
Forest Land – 2,473,675 acres
Growing Stock – 64.1 million tons
Total Biomass – 225.5 million tons
South Florida
Forest Land – 833,971 acres
Growing Stock – 15.2 million tons
Total Biomass – 142.3 million tons

NOTE: 1980 data; total biomass does not include agricultural crops or crop residues.

SOURCE: Governor's Energy Office. 1981. Florida Energy Sources.

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TABLE 3

SELECTED FORESTRY STATISTICS FOR FLORIDA: 1979

REGION	COMMERCIAL FOREST LAND AREA (ACRES)[A]	STANDING GROWING STOCK (TONS)	NET ANNUAL GROWTH OF GROWING STOCK (TONS)	HARVESTS OF GROWING STOCK (TONS)	NET UNHARVESTED GROWTH (TONS)	ESTIMATED ENERGY POTENTIAL OF UNHARVESTED GROWTH (TRILLION BTU)
Northwest	5,512,061	127,028,655[B]	6,337,725[B]	4,360,410[B]	1,977,315[B]	11.9
Northeast	6,844,470	170,791,130[A]	11,440,818	8,165,118	3,275,700	19.7
Central	2,473,675	64,123,565[A]	2,645,673	1,211,290	1,434,383	8.6
South	833,971	15,227,275[A]	561,323	466,635	94,688	0.6
TOTALS	15,664,177	377,170,625	20,985,539	14,203,453	6,782,086	40.7

NOTES: These statistics include only sound trees of commercially useful species of growing stock size. They do not include smaller trees, unsound trees or trees which are not of commercial species. Further, these statistics apply only to the timber parts of trees, not to branches, tops and roots. Totals may not add due to rounding.

A. 1980 data.
B. 1978 data.

SOURCE: Governor's Energy Office. 1981. Florida Energy Sources.

> an urgent need to implement a new comprehensive framework for the nation's biomass energy R&D program that sorts out objectives, priorities, and responsibilities. (Solar Energy Research and Development: Federal and Private Sector Roles, p. 31)

ERAB recommended that federal R&D efforts focus first on understanding and expanding the resource base and secondly, on improving the technology base for production and conversion technologies. Specific needs in each of these areas are:

1) Understanding and Expanding the Resource Base:

> — Resource assessments, including estimates of biomass production and feedstocks;
> — identifying the location and availability of unused wastes;
> — expansion of the resource base through screening and selection of plant species cataloging of plant components to identify potentially valuable chemicals, phenotype collection, insect and disease management and agronomic studies;
> — basic research in photosynthesis, electrochemistry, metabolism and other fundamental aspects of plant physiology.

2) Improving the Technology Base for Biomass Production and Conversion:

— basic research in biological and thermochemical conversion of biomass (especially lignocellulosic materials which are the most abundant);

— development of chemical feedstocks which have a higher value than fuels;

— establishment of a repository for biomass standard reference samples (as has been done with coal) to help standardize research.

It should be emphasized that these are only highlights of biomass research needs. ERAB recommended a comprehensive biomass research agenda in its "Biomass Energy" report.

- Biomass energy development faces potentially significant environmental and social constraints, but also offers opportunities to solve existing environmental problems.

One of the factors which caused ERAB to be conservative in its estimate of the future contribution of biomass energy was recognition of the significant potential environmental and social constraints which face this energy source.

Environmental concerns over the growing of biomass include depletion of soil humus and nutrients, increased erosion, degradation of water quality loss of fish and wildlife habitat and increased competition for irrigation water supplies. Biomass combustion is generally not a concern except for particulate emissions from wood stoves which are coated with potentially carcinogenic polycyclic organic materials. Biomass gasification and liquefaction can result in rather toxic by-products which are of concern for both air and water quality. Water pollution could be a concern for disposal of stillage from fermentation processes.

Two environmental concerns which are important to Florida are use of wetlands for biomass production, and introduction of new exotic plant species. Wetlands are very important in Florida for their water storage and purification functions and the state already has a major problem with runaway exotic plants such as water hyacinth, hydrilla and melaleuca.

The most important social issue facing biomass energy development is the "food vs. fuel" controversy. Although concerns have no doubt been overstated in many cases, there is little doubt that a greatly accelerated biomass production program will compete with food and fiber production. This could either cause increases in food and fiber prices or force cultivation of marginal lands which would further exacerbate environmental problems such as erosion and habitat loss.

The "food vs. fuel" dilemma can be partially resolved by concentrating biomass energy research and development on use of by-products of food and fiber

production. In Florida for example, there are thousands of tons of food by-products such as potato and carrot wastes which are being investigated as biomass feedstocks.

While there are environmental concerns over biomass energy development, it is also important to emphasize that use of biomass can help solve existing environmental problems. Foremost among these for urban areas is use of municipal solid waste as boiler fuel. This approach has limited applicability in rural areas due to low volume and dispersed distribution. However, agricultural wastes offer considerable potential for rural areas. Wastes from feedlots, dairy cattle holding facilities, hatcheries, shellfish packing houses and citrus processing facilities can be serious sources of pollution, but can be used instead as biomass feedstocks. Furthermore, when such potential pollutants are used as biomass energy sources, the "net energy" concerns over biomass energy are lessened: if a given process is providing important environmental and social benefits, it may still be cost effective even if it is a net energy loser.

There have been some important investigations in Florida of the use of animal manures to produce energy and other vendable by-products. Kaplan Industries near Bartow uses manure produced from its large feedlot operation to produce methane which, in turn is burned to produce some of the operation's electrical needs. In Okeechobee County, feasibility studies have been conducted on using manures from dairy milking parlors to produce methane, fertilizer and carbon dioxide. The Okeechobee work is especially significant from an environmental perspective because manure from an estimated 35,000 dairy cattle,

concentrated on 30 dairies in the Taylor Creek Basin, has been indentified as a major source of pollution of Lake Okeechobee. Lake Okeechobee is Florida's largest and most important lake as a source of drinking water for South Florida and is in danger of becoming excessively entrophic.

- Other renewable energy sources hold promise for rural America and deserve further research.

In addition to biomass energy applications, there are several other renewable energy sources which appear to be cost effective today for rural and agricultural uses. These include low-head hydro projects, domestic solar hot water heaters, passive space heat and cooling for dwellings and livestock buildings and solar crop drying. As previously noted, small wind machines are cost-effective in many areas. ERAB found that the small wind turbine industry is now selling roughly 1500 machines per year in the U.S. However, wind machines appear to have very limited potential in Florida due to a poor wind resource. A possible exception is pumping for irrigation, and this should be further investigated. Regarding solar hot water heaters, the Florida Solar Energy Center estimated in 1980 that there were 40,000 units in use in Florida and that an additional 18,000 would be added in 1981. It was further projected that there would be nearly three-quarters of a million residential solar water heaters in use in Florida by 2000.

There are several solar approaches for agricultural applications which deserve further research. These include:

-- heating water for dairy milking parlors;

-- greenhouse heating;

-- powering irrigation pumps using photovoltaics or parabolic dish-Rankine engine systems;

-- distilling and dehydrating.

- Continued federal role in research and development and tax incentives are crucial for renewable energy development.

Rural America is heavily dependent on fossil fuels, particularly petroleum based fuels. These fuels are finite and potentially disruptible; and that the long term economic viability of rural areas depends upon the development of alternative energy supplies. As discussed earlier, renewable energy sources show great potential for rural areas, but only if the federal government continues its commitment to conduct basic energy research and development for which there are insufficient free market incentives. This was perhaps the most significant finding of the ERAB Solar R & D Panel. The federal commitment does not have be large in terms of extravagent demonstration projects, but it must be stable, enduring and comprehensive.

Finally, the ERAB Solar R & D Panel heard again and again from industry, university and government witnesses that continuation of the Business Energy and Residential Tax Credits is crucial to the near-term survival of the solar industry. These credits correct for market imperfections which favor conventional energy sources. The Panel recommended that the credits be extended

until 1990, but with a specific phasedown schedule beginning in 1986. Similiarly, the Panel concluded that the Public Utilities Regulatory Policy Act (PURPA) has played a significant role in encouraging the use of small renewable electric generating projects. PURPA requires that utilities purchase power from third party power producers at a negotiated price based on avoided cost. This provision, like the tax credits, was deemed essential to the near term survivability of the renewables industry and should be continued.

Mr. Chairman, that concludes my testimony. I would be happy to answer any questions.

Mr. FUQUA. Thank you very much, Ms. Tschinkel. We appreciate that very much.

Dr. Kidd?

Mr. KIDD. Thank you, Congressman Fuqua.

I want to, on behalf of Florida A&M University and Dr. Walter Smith, its president, thank you for the opportunity to be here to testify before the Subcommittee on Energy this afternoon.

We are very close to rural Florida, under-resourced peoples in Florida. They have been our clientele and they have been our students for the entire existence, almost 100 years, of our university. I think it has been well established by my colleagues here this afternoon that Florida is energy dependent.

I don't think the situation really needs to be described in any greater detail, in addition to what they have said. I just simply want to say one other thing with respect to the situation here in Florida, and that is that pesticide consumption by Florida agriculture is also among the highest in the Nation.

In 1974, Florida was 5th in the use of insecticides, 3d in the use of fungicides, and 32d in the use of herbicides. On a per acre basis, Florida leads the Nation in both total pesticides and insecticide use. It is disturbing to realize how energy dependent one of Florida's major lifelines is.

There are many needs and opportunities, and I think opportunities for positive impact, as we look at the energy situation, as we look in particular at the rural community. Energy savings in rural communities will be greatly influenced by the size of the community, by the number and makeup of its businesses, by the community facilities and services, and the attitudes of local government.

The attitudes of citizens in local government on development, land use, zoning, siting, subdivision, waste disposal, and building codes could have a significant long-term benefit to the communities and its social economic and environmental well being.

Rural communities can reduce natural gas and petroleum use appreciably by adopting energy efficient management and procure-

ment practices, by adopting and utilizing renewable energy resources, and by developing long-range comprehensive energy plans.

The household is a critical unit for bringing about reduced consumption and better utilization of energy. However, lack of specific information about the consequences of energy consumption and managing practices of the household has limited some programs' abilities to reduce home energy uses. Energy information is needed relative to food and fiber utilization, structure and location of housing, household management practices, and family living patterns.

Appreciable amounts of crop, forest, and food processing residues in excess of those required for maintenance of soil and fertility and erosion control might serve as sources of alternate fuels. Such residues are currently used as sources of fuel for direct fire of boilers, for process heat, for production of oil and gas by petrolysis and for the generation of methane gas from animal waste.

Use of passive solar systems would eliminate the need for thermal storage of grain. Energy savings opportunities also exist for such operations as irrigation pumping, environmental control for livestock, and integrated energy management for farmsteads.

The safe practical application of solar, wind, or biomass energy for farm production and for the transfer of that electricity to existing power systems requires thorough research.

The potential economies in energy use are possible through improving the life of, the timeliness and effectiveness of fertilizer, pesticide, and herbicide applications while maintaining or increasing crop productivity.

Improving nitrogen fixation of legumes to increase their usefulness in short- and long-term crop rotations, to decrease reliance of cropping systems on nitrogen fertilizers manufactured from natural gas, matching tractor size to implement power requirements, improving the efficiency of irrigation, water pumping, delivery use; using minimum rather than conventional tillage practices, adopting solar and low temperature grain drying procedures, properly insulating greenhouses and animal confinement facilities.

There are many research objectives and needs which our institution reviews or participates in at one level or another at the present time, but there is room for improvement.

We need to establish a comprehensive data base on energy use in all aspects of the entire food system and in rural communities. Energy needs by month should be documented by enterprise, operation, or end use, and energy type.

This data base is essential for planning and evaluating energy conservation programs and for establishing energy allocation programs in the event of energy shortages.

We need to develop energy conservation goals and management guidelines for all components of the food system and rural living.

We need to develop or adopt technology for various renewable energy applications on farms, rural households, and in communities.

We need to investigate new crop and livestock systems that are more energy efficient than those presently used, including integrated systems that bring together a number of conservation and substitution technologies.

We need to investigate new crops, both annuals and perennials that increase biomass yields to reduce energy requirements for both.

In extension, we also have some concentration of effort that we think deserves attention. We need to designate the transfer of energy technology and efficient management of energy as a priority program.

We need to develop a comprehensive energy outreach program that will include resource conservation, renewable alternatives, and energy mangement, as related to food and agricultural systems, rural housing, family living, and rural communities, and as related to adjustments that families and communities should make in order to maintain or improve their quality of life.

There are several program priorities which we hope will receive attention in terms of dollars and support from the State and the Federal Government. We think the priority programs for agriculture in the food system include the development and implementation of more efficient tillage and irrigation practices, and fertilizer pesticide and herbicide applications.

Matching of power units with implementation for most efficient fuel use, proper matching of power units to the load in stationary farmstead operations, regardless of energy use or source.

Energy management and safety education for both traditional and renewable energy production systems. Education emphasizing energy policy, regulation, principles and applications as they relate to resource management and resource conservation on the farm.

Priority programs for family living and housing including promotion of maintenance and prudent use of major home appliances, development of improved technology for weatherization, insulation, home construction, promotion of family directed conservation and utilization of programs for energy and nonrenewable resources, development of a data base on energy uses in rural areas, establishment of family housing demonstration projects in weatherize retrofitting and landscape management, provision of energy information and use of housing, appliances, household furnishings and clothing and selection and preparation of food.

Development of financial management education programs to help families cope with increasing energy practices or prices.

Establishment of family housing demonstration projects in which solar, passive and active is used as an energy source for home heating and cooling, and in which various backup heating systems that burn wood and coal efficiently and safely are included.

Establishment of effective linkages with assistance programs to help families cope with increasing energy prices.

The development of plans for energy efficient and solar heated houses to meet the needs of rural families.

Development of research and demonstration programs in cooperation with the building industry and with FHA and other providers of assistance to help gain acceptance of innovative and more energy efficient housing.

Such programs can provide a field of experience for graduate students and training opportunities for extension staff, planners and builders of rural housing.

Assessment of safety and effectiveness of new energy conservation practices related to food and fiber uses by families.

Initiation of programs that help families cope with energy situations caused by energy shortages or interruptions in energy supply.

Initiation of programs that encourage families to participate in energy policy formulation; that is, transportation, recreation, marketing, tax structures, and subsidy programs.

Priority programs for rural communities in particular would include formulation of comprehensive community energy plans, development of cost-benefit analyses for the impacts of various management and conservation options on the sectors that will be affected by the energy plan.

Developing of cost-benefit analyses for impacts of energy substitutions, and renewable energy resource options on the sectors that will be affected by the energy plan.

Expansion of studies that include economic, social and environmental impacts of a community energy plan.

Assessment of legal implications of various energy options.

Establishment of community demonstration projects on energy conservation, integrated energy management, renewable energy, and waste recovery options.

Review and revision of planning, zoning, siting, subdivision and building code regulations for efficiency, for use of renewable energy resources, and for substitution and conversion opportunities.

Development of energy efficient concepts and technologies for renovation of existing and construction of new community facilities.

Evaluation of the energy efficiency of systems for distributing goods and for transporting people.

In conclusion, I would just like to say that all these things are at one level or another being carried out by State agencies, and certainly the universities, including Florida A&M University, are playing their part. We at Florida A&M University, having had a long affiliation with and dependency upon rural communities and under-resourced peoples elsewhere in the State of Florida, feel very close to this issue.

As a matter of fact, as the agencies visit us, as we try to administer and take part in the State extension program, we find that we could use some help and flexibility with regard to those extension budgets.

Our extension program, as my colleague Dean Woeste will probably support, is quite a tight situation. We have 4-H activities, we have outreach programs, and we account for them on a yearly basis, and there isn't very much room for us to reach out and to get other elements of the university community in close proximity to rural populations and their needs. We would like to be able to do that, and we should do that.

We generate proposals for research in the energy area, but service is as important, if not more important, and we look for flexibility and ways of doing that.

[The prepared statement of Dr. Kidd follows:]

Prepared Statement of Dr. Charles C. Kidd, Sr.

INTRODUCTION

Few subjects have generated as intense and prolonged a public debate as has the energy crisis of the 1970's. The erratic behavior of foreign governments, global weather patterns, and domestic policymakers has created confusion among the American public about the severity of our national energy problem and has hindered the development of a national strategy to cope with the crisis. This situation has rendered the world's most energy-intensive economy, in which per capita energy consumption is six times that of the world's average, highly vulnerable to foreign energy sources. For Floridians the problem is particularly acute, since the major income producing activities of the state (agriculture, construction, and tourism) are energy demanding industries which are dependent on foreign sources of energy.

The twin elements present in all crises are "danger" and "opportunity" both clearly applicable to the energy fuel shortage in Florida. Firstly, one inherent danger is the fact that for a variety of reasons, the state's rapidly growing rural population may not be keenly attuned to the short and long range effects the energy "crunch" may have on their lives and livelihoods. Secondly, and it is too often overlooked is the opportunity presented for optimum utilization of Florida's agricultural resources for developing energy fuel alternatives.

Between 1960 and 1976, the total energy consumed in Florida increased by 173 percent, while for the nation as a whole the

increase was only 68 percent. It should be noted here that the population of Florida increased by 73 percent during that same time span. In 1979 Florida's average total energy consumption per person, at 254.3 million Btu's, was substantially less than the average of the United States at 374.9 million Btu's per person. Nevertheless, it is encumbent upon Florida's citizens to conserve energy when possible.

In his energy speech to the nation on April 5, 1979, the President reaffirmed the three basic goals of his energy policy: to increase domestic energy production, to encourage greater energy conservation, and to stimulate the use of our vast technological resources to develop alternative energy sources so that we can reduce our dependence on imported oil. Since the 1979 White House call for "an all out effort to increase domestic energy production "technologies with agriculture as their base" have been accorded the highest priority. In the State of Florida a Governor's Energy Office has been structured with Executive Chamber mandated to meet the crisis head-on through conservation, education and full utilization of the states vast natural resources as fossil fuel alternatives.

II. ENERGY CAPABILITIES AND OPPORTUNITIES

Agriculture and rural America are on the threshold of a new era that promises to be as challenging and exciting as any in past history. Analysis of data and information gathered in research clearly indicates that by combining existing technologies

and innovative approaches geared to their special needs, Florida's rural areas can become the principal resource for the development of alternate energy fuels.

SITUATION

A. Rural Community Sector

Significant impacts can be made on the economic, social and environmental conditions of rural communities and their people through reduction in the energy used both directly and indirectly by communities. People in a community can utilize known energy resources more effectively and extend limited supplies of natural gas and petroleum by evaluating the energy impacts of economic development, capacity building, community facilities and services, recreation, transportation, housing and land use.

Families living in rural areas often require more energy than their urban counterparts. The rural resident sector uses about 3-4 percent of the state's energy consumption directly arid a much larger amount indirectly. The percentage of old, energy-inefficient housing is higher in rural than in urban areas. The farm home is usually the center of farm management operations, and frequent trips in and out of the house increase the energy required for maintaining a comfortable temperature, for routine cleaning, and for replacement of home furnishings. In addition, rural families often must provide their own water supply and drive many miles for shopping, community services, activities or emergency repairs on farm equipment. Most rural residents

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lack easy access to public transportation. Rural families use additional energy for growing and preserving much of their own food. Laundry needs are considerable because family members work in adverse weather conditions, handle fertilizers and insecticides, and work with livestock, and soil, odors, and pesticide residues must be removed.

B. Agriculture

According to statistics, Florida agriculture, directly and indirectly, consumed 97 trillion BTUs in 1974, which accounted for 5.3 percent of the state's total energy consumption and ranked Florida tenth nationwide in energy confirmed for agriculture.

Florida uses more gasoline, diesel fuel, fuel oil and LP gas per acre for agricultural production than almost any other state. Fuel oil consumption is maily for protection from cold weather. Diesel fuel is of course, used for field operation and irrigation. Gasoline is used for field operations and vehicles. LP is used for irrigation and crop drying.

It is important to realize that fertilizer represents one-third of the energy expended in crop production. Florida soils require seven times as much fertilizer per acre as the national average for crops. The state is the third largest consumer of fertilizer in the nation on a BTU per acre basis.

Pesticide consumption by Florida agriculture also is among the highest in the nation. In 1974, Florida was fifth in the use of insecticides, third in the use of fungicides, and thirty-

second in the use of herbicides. On a per acre basis, Florida leads the nation in both total pesticide and insecticide use. It is disturbing to realize how energy-dependent one of Florida's major lifeline is.

II. NEEDS, OPPORTUNITIES AND IMPACTS

A. Rural Community

Energy savings in a rural community will be greatly influenced by its size, by the number and make up of its businesses, by its community facilities and services, and by the attitudes of local government. The attitudes of citizens and local government on development, land use, zoning, siting, subdivision, waste disposal, and building codes could have significant long-term benefits to the communities and its social, economic, and environmental well-being. Rural communities can reduce natural gas and petroleum use appreciably by adopting energy-efficient, management and procurement practices, by adapting and utilizing renewable energy resources, and by developing long-range comprehensive energy plans.

B. Home and Family

The household is a critical unit for bringing about reduced consumption and better utilization of energy. However, lack of specific information about the consequences of energy consumption and management practices of households has limited some programs ability to reduce home energy usage. Energy information is

needed relative to food and fiber utilization, structure and location of housing, household management practices, and family living patterns.

C. Renewable Resource Technologies

Appreciable amounts of crop, forest, and food processing residues (in excess of those required for maintenance of soil fertility and erosion control) might serve as sources of alternative fuels. Such residues are currently used as sources of fuel for direct firing of boilers, for process heat, for production of oil and gas pejrolysis, and for generation of methane gas from animal wastes.

D. Agriculture

Use of passive solar system would eliminate the need for thermal storage of grain. Energy saving opportunities also exist for such operations as irrigation pumping, environmental control for livestock, and integrated energy management for farmsteads.

The safe and practical application of solar, wind, or biomass energy for on-farm production and for that transfe: of that electricity to existing power systems requires thorought research.

E. Food Production and Processing

Potential economies in energy use are possible through:

- Improving the timeliners and effectiveness of fertilizer, pesticide and herbicide applications while maintaining or increasing crop productivity.

- Improving nitrogen fixation of legumes to increase their usefulness in short- and long-term crop rotations to decrease reliance of cropping systems on nitrogen fertilizers manufactured from natural gas

- Matching tractor size to implement power requirements

- Improving the efficiency of irrigation-water pumping, delivery and use

- Using minimum rather than conventional tillage practices

- Adopting solar and low-temperature grain drying procedures

- Properly insulating greenhouses and animal confinement facilities.

F. Research

- Establish a comprehensive data base on energy use in all aspects of the entire food system and in rural communities. Energy needs by month should be documented by enterprise, operation or end use, and energy type. This data base is essential for planning and evaluating energy conservation programs and for establishing emergency allocation programs in the event of energy shortages.

- Develop energy conservation goals and management guidelines for all components of the food system and rural living.

- Develop or adopt the technology for various renewable energy applications on farms, in rural households, and in communities.

- Investigate new crop and livestock systems that are more energy efficient than those presently used, including integrated systems that bring together a number of conservation and substitution technologies.

- Investigate new crops, both annuals and perennials, that increase biomass yields to reduce energy requirements or both.

G. Extension

- Designate the transfer of energy technology and the efficient management of energy as priority programs.

- Develop a comprehensive energy-outreach program that will include resource conservation, renewable alternatives, and energy management as related to food and agriculture system, rural housing, family living, and rural communities and as related to adjustments that families and communities should make in order to maintain or improve their quality of life.

III. PROGRAM AND PRIORITIES - CONSERVATION AND MANAGEMENT

A. Priority Programs for Agriculture and the Food System Include:

- Development and implementation of more efficient tillage and irrigation practices and fertilizer, pesticide, and herbicide application systems.

- Matching of power units with implements for most efficient fuel use.

- Proper matching of power units to the load in stationary farmstead operations, regardless of energy form used.

- Energy-management and safety education for both traditional and renewable-energy production systems.

- Education emphasizing energy policy, regulation, principles, and applications as they relate to resource management and resources conservation on the farm.

B. Priority Programs for Family Living and Housing Include:

- Promotion of proper maintenance and prudent use of major home appliances.

- Development of improved technology for weatherization, insulation, and home-construction that will conserve energy.

- Promotion of family-directed conservation and utilization programs for energy and nonrenewable resources.

- Development of a data base on energy usage in rural areas.

- Establishment of family-housing demonstration projects in weatherizing, retrofitting, and landscape management.

- Provision of energy information on household practices related to selection and use of housing, appliances, household furnishings, and clothing, and selection and preparation of food.

- Development of financial-management education programs to help families cope with increasing energy prices.

- Establishment of family-housing demonstration projects in which solar--passive and active--is used as the energy source for home heating and cooling and in which various backup heating systems that burn wood and coal efficiently and safely are included.

- Establishment of effective linkages with the assistance programs to help families cope with increasing energy prices.

- Development of plans for energy-efficient and solar-heated houses to meet the needs of rural families.

- Development of research and demonstration programs in cooperation with the building industry and with FmHA or other providers of assistance programs to help gain acceptance of innovative and more energy-efficient housing. Such programs can

provide field experience for graduate students and training opportunities for Extension staff, planners, and builders of rural housing.

- Assessment of the safety and effectiveness of new energy conservation practices related to food and fiber use by families.

- Initiation of programs that help families cope with emergency situations caused by energy shortages or interruptions in energy supply.

- Initiation of programs that encourage families to participate in energy policy formation (e.g., transportation, recreation, marketing, tax structures, and subsidy programs).

C. Priority Programs for Rural Communities

- Formulation of comprehensive community energy plans. ✓

- Development of cost-benefit analyses for the impacts of ✓ various management and conservation options on the sectors that ✓ will be affected by an energy plan.

- Development of cost-benefit analyses for impacts of energy substitutions and renewable energy resource options on the sectors that will be affected by an energy plan.

- Expansion of studies to include economic, social, and environmental impacts of a community energy plan.

- Assessment of legal implications of various energy options.

- Establishment of community demonstration projects on energy conservation, integrated energy management, renewable energy, and waste recovery options.

- Review and revision of planning, zoning, siting, subdivision, and building code regulations for efficiency, for use of renewable energy sources, and for substitution and conversion opportunities.

- Development of energy-efficient concepts and technologies for renovation of existing, and construction of new, community facilities.

- Evaluation of the energy efficiency of systems for distributing goods, and for transporting people.

Mr. FUQUA. Thank you very much, Dr. Kidd.

Mr. Thayer, many of the energy programs, if not all of them, are funded on a formula basis, is that correct, like the Energy Extension Service and some of those?

Mr. THAYER: That is correct. It's a very interesting question. Most of the funding allocation formulas are very, very fair. However, there are always a few exceptions to that rule. In the case of the State energy conservation plan, there are three elements involved in that funding allocation formula.

Of course, there is the equal shares provision, then there is a portion that is dependent on projected energy savings, and the final element is the population. Unfortunately for the State of Florida, the SECP population is the 1976 population, and with the State of Florida in such an extreme growth position, we just do not feel that this is the proper course to pursue.

We were hoping that the Department of Energy would amend their rules and they did take steps to do that this year; however, they decided that they would have to wait until next year to make these revisions and so this will once again cost the State of Florida.

Mr. FUQUA. It's in their revision, not in the law?

Mr. THAYER. It is not in the law, it is in the rule.

Mr. FUQUA. Dr. Kidd, what example—you cited some, that—the State and Federal Government should be doing in order to promote energy sufficiency, particularly in the rural areas? Do you have—you outlined, as a matter of fact, quite a number of them. What do you consider the most important?

Dr. KIDD. I think one of the most important concerns that I have, as I look at farming operations in northwest Florida, and north Florida generally, is insecticides, the use of herbicides, and what we do to maintain——

Mr. FUQUA. Which have a petrochemical base.

Dr. KIDD. Yes, they have a petrochemical base, and I think it's going to take some concentrated research effort and demonstration projects, to even make a dent in that, or try to turn it around.

We have a very hard time convincing land-dependent peoples that they ought to adjust what they expect in terms of productivity, without having something to give them as a substitute; that is, conservative of energy, and we'll have to have research to do that.

There are some success models, but they are not generally applicable, and I think research of that nature has to be regional and we have to do some research on the crops and in the areas that the farmers that are in our constituency will really understand and try to adopt some of those practices.

Mr. FUQUA. I was explaining to Congressman Sensenbrenner that not only do we have a beautiful and wonderful climate here and the people like it, the Lieutenant Governor mentioned tourism is our number one industry, but also all the parasites, and bugs, and every other varmint you can think of likes this climate, too, so we have more than our share of parasites that feed off of our crops, and our foliage, and requires more than a normal amount of some type of control.

Ms. Tschinkel, you mentioned just briefly that biomass would have less adverse impact on our environment than maybe some of the other conventional types of energy sources. It's been brought to

my attention that—and you mentioned like burning wood has another byproduct that can, may or may not, however, it's probably better than burning coal.

Could you elaborate on your statement why it would be better for the environment for, say, the use of biomass rather than the more conventional fuels?

Ms. TSCHINKEL. Well, of course, it depends on what conversion technology one uses, but if you can go to some kind of gasification process, then you have very good opportunities for reducing SO_2 emissions, for example.

Even with direct burning of a number of biomass fuels, you're not going to have the same kind of acid rain problems that we have.

Also, biomass, because it takes CO_2 and converts it and generates CO_2, is not just a one-way sink, developer of CO_2 in the atmosphere. I do think that one of the problems that we face as a regulatory agency is in determining the appropriate controls for large-scale biomass plants, such as the Florida State Hospital plant, and I think that's an area where the Federal Government can really pick up the slack in research so that we can understand what the appropriate controls are for those biomass options that do have air quality problems.

Mr. FUQUA. And that's a demonstration problem to prove the technology?

Ms. TSCHINKEL. That's right, sir.

Mr. SENSENBRENNER. I do have two questions. First, as to Ms. Tschinkel, I personally am convinced that one of the major ways of helping rural areas become energy independent is through increased biomass research and utilization, and I think you touched upon that in your testimony.

But my question for you is, given the fact that we're a legislative body which is basically a funding agency rather than an administrative agency, how do we in the Congress accept your suggestion that we refocus the biomass program simply by reauthorizing the R&D funds that are used by the Department of Energy either directly or through grants to look into biomass.

Ms. TSCHINKEL. I was trying to list eight important issues and the refocusing was certainly one of them. I thought that it's appropriate that this matter was brought to the attention of the Secretary of Energy directly and wanted to mention that to you, and I understand that they are going to take some steps inside the department, independently, in taking the advice of the board.

Obviously, an authorizing body also has an opportunity to ask questions about program management, and I'm sure that you use that.

Mr. SENSENBRENNER. But as an administrator, frequently you know that goes in one ear and out the other.

Ms. TSCHINKEL. I take my money people pretty seriously and I'm pretty sure that DOE does also.

Mr. SENSENBRENNER. One of the most successful energy projects in the rural part of my district involves a gentleman who has a chicken farm with about a third of a million chickens in his coop, and he has used the digester that was developed by scientists at the Unviersity of Wisconsin to generate methane gas from the

chicken manure, which is sufficient to heat his chicken coop and to generate enough electricity to keep his chicken coop, and his sorting, and grading, and boxing operation running, as well as making a purer effluent for the municipal sewerage system, and as well as having 78 percent of what came out one end of the chicken being eligible to be put into the other end of the chicken as feed. This was all done with a relatively small research grant to the University of Wisconsin.

My question of Dr. Kidd is, do you have any programs like that at Florida A&M?

Dr. KIDD. We don't have any programs specifically like that at Florida A&M. We have a program, we have put in an application recently to agricultural research station, which is one of the, or research service station headquarters and in your region and we're waiting right now. It is a program that does follow the pattern of research that you have just described, and it's been submitted by some of our entymology faculty and it was submitted, well, about 9 months ago. We haven't heard anything about it yet.

Mr. SENSENBRENNER. You see, I look at one of the problems of, that all of us face, is that very frequently when we talk about energy programs and problems, we can get very preachy, saying we know what's good for you and you ought to listen to us.

Well, that usually doesn't get very far, particularly when you're talking to rural people who are very independent, and they make up their own minds, and I think you made a very good point that perhaps too much pesticide and fungicide which have a petrochemical base are being used, but if we cut down on that, we also might cut down on the productivity or yield per acre of whatever is being produced on that farm.

Now, going into the biomass programs, I think we can show that there can be a tradeoff, that we can save you some money in terms of our outlays, energy outlays if you get into biomass which may very well end up offsetting, perhaps, a little bit lower yield as a result of overuse of petrochemical-based pesticides and fungicides. That's my preaching. Thank you.

Mr. FUQUA. Amen. Mr. Nelson?

Mr. NELSON. Let me ask Ms. Tschinkel first, what barriers do you see to encouraging rural economies, such as this part of the Nation, to move away, what barriers are there for us to get these rural economies moved away from dependence on oil?

Ms. TSCHINKEL. Well, there's obviously several. One important one is the fact that a lot of the biomass options are probably cost effective but they are marginally so and people don't want to take a risk in that environment with a great deal of flux, particularly in the tax policy. What looks cost effective this year, may not continue to be so you continue to invest in it.

I think the second barrier is that because of marginal economies in some cases, we've seen programs implemented that were very promising, worked physically, but have to be shut down for a few years until it becomes promising again, and I think we need to encourage to make it cost effective so that people can become familiar with the technology which is working, put it into place. I think those are probably the two key areas I would mention.

Mr. NELSON. Dr. Kidd mentioned that Florida is first in the United States for the total insecticide and herbicide use?

Dr. KIDD. That's right.

Mr. NELSON. Well, that really presents a problem for you in your agency, doesn't it, Ms. Tschinkel?

Ms. TSCHINKEL. In fact, I thought that was a marvelous point, and it seemed to me that we have a lot of options here for trying to do something where energy issues and environment issues can work closely together.

We've had some real pesticide-related headaches in Florida this year as you probably well know, and we need some answers to some options we can offer the agricultural community on pesticide use.

Mr. NELSON. What do you think, both of you, what do you think some of those options might be?

Ms. TSCHINKEL. Well, there are two things I would mention and then Dr. Kidd might add some things. One is whether there are some farming practices that would not be energy-intensive that might reduce the burden of pesticides.

With our long growing season pests have lots of time to multiply and get active so we need some different farming practices. A second point is application rates.

Mr. NELSON. What would be an example of Florida?

Ms. TSCHINKEL. Well, maybe you till at different times of the year, or till in a different way, or you don't till—that kind of thing might make a less attractive habitat for pest.

The second thing is application rates. You know, we take the word of the producers of insecticides pretty much for granted as to what application rate is appropriate. I don't mean any disrespect, but they're in the business of selling products. If we can get independent organizaitons like IFAS and the other universities to do research on application rates and application times, maybe you can use a lot less than if you apply at the times prescribed. Those would be two areas I would mention.

Dr. KIDD. I think that in addition to those operational approaches, the research that we're interested in in terms of entymological research revolves around sterilization, biological control, by predators for some of our pesky friends, and also in practices, not so much just planting times, but types of soil, and other ways of providing nutrients, and other requirements.

So we really want to do laboratory research, as well as demonstration projects. We do that now to a certain extent. We have a nematode project in this area, with the cooperation of the farmers, and it works, but we also need to do some laboratory research on some of our most economically disastrous pests, and I think if we can do that, if we can find biological ways of controlling insects and pests, then we can eliminate the need for so much in the way of herbicides and pesticides that are petroleum based.

Mr. NELSON. What other ways of supplying nutrients did you have in mind?

Dr. KIDD. Well, there are other chemicals that you can add to the soil, there are ways of deriving some of the nutrients that we need from sea water, some of that kind of research is going on now. We would like to see intensification in that area of research.

Mr. NELSON. By the way, Mr. Chairman, you were so much in the forefront of the Nation's space effort back when you chaired the Space Subcommittee, have there been any spinoffs from the high technology that was developed over the space program that would have direct application? The photovoltaics are certainly one. What, just off the top of my head, I'm trying to think of others that might have been.

Mr. FUQUA. Well, I don't know yet where they will go, but many of, some of the new materials that were developed that are not only more energy efficient, some of the work we're doing in ceramics and other things, in particular lightweight materials. You know, if you make a tractor lighter that's less weight you have to pull around and so that all has an energy relationship.

Mr. NELSON. Maybe you can——

Mr. FUQUA. We're working also on turbine engines that is a spinoff of the space program, some of the engine technology that is much more efficient and smaller and less bulky as say some of the diesel or gas-powered engines that we have now. All of that had a genesis through some of the space activities.

Mr. NELSON. You know, I'm absolutely intrigued, we had so much difficulty with *Columbia* when we were first attaching all of those tiles, those silicon-based tiles, and now they're working so beautifully. And now, we even put a silicon-based blanket in the place of tiles and wouldn't it be something if we could take that high technology and utilize that for insulation in the future? It's so lightweight, it can stand 2,000 to 3,000 degrees on one side you can hold it in your hand and the other side be cool.

Mr. FUQUA. And less than an inch thick.

Mr. NELSON. That's correct. The implications for insulation are just absolutely mind boggling.

Let me ask you, Mr. Thayer, you mentioned IFAS as one instrument in the State that is helping us with regard to energy applications in rural areas.

Mr. THAYER. Yes.

Mr. NELSON. What other specific areas are you really promoting energy alternative fuels as well as energy conservation, through the State program, for rural areas? We're looking at the potential for utilizing vegetable oils to replace the diesel fuels that are currently used in our tractors.

Mr. NELSON. And what department is doing that?

Mr. THAYER. That's the U.S. Department of Agriculture, and it's being networked through IFAS. IFAS is continuing that research.

Aside from that, I'm not too familiar. I'm sure that when Dr. Smith comes up to talk about the biomass-related research, that he would be more familiar with that.

Mr. NELSON. Do you find there is a difference in the acceptance of your program for conservation, is there a difference in the acceptance of that, in the rural areas, versus the urban areas?

Mr. THAYER. We firmly believe that the rural areas are adapting very rapidly. Our county energy information centers have shown that the rural audiences were the first to go out and aggressively secure our literature and information, and frequently come back with very involved questions that we have to refer back to the university in order to give them the proper answer, so we think that

the rural audiences are definitely trying to take control of their life.

Mr. NELSON. Does that mean there's more acceptance in the rural areas to begin with than in the urban areas?

Mr. THAYER. I would say so, yes. They understand that their lifestyle is very energy intensive.

Mr. NELSON. I see. Very interesting. Thank you, Mr. Chairman.

Mr. FUQUA. Thank you. I think Dr. Kidd included that in his statement about not only washing clothes, where you are out working in a field, you have odors, around animals, perspiration the energy intensiveness, you usually have a freezer, you prepare food, and can—many other things that rural people do, and I'm glad they do it.

Mr. Lewis?

Mr. LEWIS. Thank you, Mr. Chairman.

Mr. FUQUA. The peas taste good as——

Mr. NELSON. They weren't canned, though.

Mr. LEWIS. Mr. Thayer, the onus has been placed on the utilities in Florida to provide audits, energy audits. They do a lot of advertising, radio and television, as far as energy conservation. What have you found has been their role in providing alternative energy sources, or for promoting alternative energy sources?

Mr. THAYER. Well, at this point in time the Public Service Commission is looking at cogeneration rates, or buy-back rates for solar and for other cogeneration. The utilities were initially a little skeptical of that because there are a lot of interconnect problems in buy-back rates, et cetera, but they have recently decided that this is a very attractive approach for them to pursue and have developed educational programs to provide the state-of-the-art information that is necessary for those high-tech and exotic systems.

Mr. LEWIS. I want to, I guess, work all three of you against each other maybe, just for a moment. But with all of your various testimonies, you bring out, particularly Secretary Tschinkel, the biomass, and there are counterproductive areas there, as well, the education for our people who would be working on the housing and providing energy, education to other people in the rural areas, as well, my concern is that for every—we don't have the—you haven't talked about the trade offs to some extent.

In Florida, when I was in the Florida Legislature, I was on the Florida Energy Committee that we had, I worked with Congressman Nelson on the house growth and energy, most of the legislation, I was a part of what we have today in Florida, but we always have the opposite swing in the pendulum every time we thought we were making progress.

We have the wood chip program going on at Chattahoochee, and this causes air pollution. It causes a possible acid rain problem. We—Dr. Kidd, you are concerned about pesticides and herbicides that Congressman Sensenbrenner mentioned, but IFAS has worked extremely hard for the past several years to provide more per acre by exceptionally good use of these commodities.

Now, we're looking at the fact that we're coming back and—and we should be using that wind, too, but we're coming back now and saying, well, now, this is harmful, so this again, by cutting back on this, if we can't come up with a better way to get a better yield per

acre without the use of these commodities, and again we're going to hurt indirectly and directly hurt the economy, so when we say we want to work to provide better rural energy, renewable energy sources, what do we have to give you, and if we don't have to give it up, what's the best way to get there from here?

Ms. TSCHINKEL. Can I comment? Because you used an example, which was the Florida State Hospital at Chattahoochee. I think it's like everything else, I mean, you never get something for nothing.

Mr. LEWIS. That's true.

Ms. TSCHINKEL. That's practically a law of physics, I guess, and almost any facility that you're going to build for generating energy on a large scale is going to have to have some environmental controls associated with it.

There's always going to be, unless you're burning pure gas, in which case you have an effluent to worry about, usually from making the gas from some artificual sense, but that's quite controllable. They're going to be putting on either a bag house or a precipitator, I can't remember which it is, to control particulates, and they're going to have very clean emissions from that facility.

So I think you always have to look at what your alternatives are and we pick the best alternative and move forward from there.

And of course, occasionally, you might make a mistake, but I think the progress has been very steady, at least the national statistics on biomass shows that overall, it's catching on, projects are working, everything is being improved, but it's a steady progress, and that's all we can hope for, really.

Dr. KIDD. I think the pesticide research, or the yields of research that's been conducted by IFAS for a long period of time, is a good example. While we're concerned about the use of and application of and waste of petroleum based pesticides and we know that we need high yeilds. I don't believe that we need to think in terms of feast or famine, I think that this is just a practical example of the fact that while we must have the kind of productivity we need to feed people, at the same time we have an obligation to conduct parallel research that will improve that process.

I would assume, in fact, I'm quite sure that a part of the research effort of scientists at Gainesville who are working toward increasing productivity through the use of pesticides was the effective and efficient use of those pesticides and herbicides, and only using those quantities that were required to do the job. That's one phase of research and application that has conservation in mind.

The other kind of research that needs to go on at the same time is research on the pesticides themselves. The problem you have with any kind of long-lived contaminant is just that, the fact that they do stay around, and I would assume that the mechanism that we put in place to do productivity studies can be also turned to good use in terms of trying to come up with shorter-lived, but effective pesticides.

Again, that will solve some of our problem, but at the same time, we need to talk about and study and research and find alternatives.

I think, no, you don't get something for nothing, but the single-line approach, the thought that, you know, you go one way and you do one thing, and you keep on with that regardless of what the out-

come is, is probably something that has plagued our research efforts.

Research, for whatever reason, has to be planned, and it is comprehensive, just like most things. So I think that things have to go on in tandem. There has to be parallel research with conservation in mind, while we continue to effect greater productivity through our research.

Mr. THAYER. I don't think it is a situation of what are we going to do that hurts the least; I think that there are some real positive benefits that are going to come out of this.

Our technology will overcome a lot of the problems which we are recognizing as we move into some of these new renewable systems.

For instance, we have been using fireplaces for years and years. We can actually reduce the emissions, the harmful emissions by utilizing catalytic combustion units in the fireplace.

In the field of biomass, after you finish with what you have put in your digester, the residue can actually be utilized as a fertilizer to reduce our dependency on petroleum, intensive fertilizers. So we feel that not only is this the necessary course, but as we move down this road, we are going to determine other spin-off benefits.

Mr. LEWIS. Well, then we all know that fossil fuels, and I think we are on borrowed time—at least I believe that, have believed it for the past 10 years.

We have an educational process now for the petroleum companies because they would rather sell super leaded, leaded, than unleaded. We have no fossil fuel problem, but certainly we are concerned about, again, another OPEC embargo or that happening.

I am not so much concerned about that as I am concerned about the well going dry, and this sooner or later has got to happen. We have got to have these alternatives, so we, as the American public, can sit back and drive our cars and drop off getting—now we are worried about hurting the car manufacturers, so we are going to reduce the requirement to get more mileage per gallon.

What do you think the government's role is and what should we, as Congressmen on this subcommittee, recommend to help the State of Florida, in what way, to provide renewable energy sources for our rural areas that would be meaningful, acceptable to the Department of Environmental Regulation, economically feasible, that sort of thing?

Should we be providing the full research and development funding for this, or do you feel that the States should be a part of this?

Mr. THAYER. We feel that the States should definitely be a part of this. However, we do think that the Federal Government should continue to stress the need for constant movement in that direction. We need to keep that level of awareness, but, of course, the States should participate.

Mr. KIDD. I definitely feel that the State should—in fact, us—have responsibility in this area. However, I think that Florida is probably a good example of an area of the country wherein it is not just the residents of the State of Florida that benefit from what we do here, but probably the entire Nation.

Therefore, I think that we need to go full speed ahead and that almost implies that we need Federal help to do some of these things in a timely fashion.

Ms. TSCHINKEL. I have only got two comments to make on that. One is we need to share our expertise with other States, and we don't need to duplicate a lot of things.

On the other hand, there is a lot of work that needs to be done almost on a 1-to-1 basis on renewables with people that other people have confidence in, so that that interface is very important at the State level.

But the basic research needs to be done at the universities or places that have the best minds to handle that particular problem.

I guess the most important thing of all—I hate to say this to you with your party affiliation—but we need to avoid mixed signals. We need a common philosophy on energy matters to guide us in all our different activities, whether it is environmental regulation, pricing policies, taxing policies, everything; you know, a national commitment that is well expressed and well accepted by everybody. I think that is the most important thing of all that Congress could do for us.

Mr. LEWIS. I couldn't agree with you more.

Mr. FUQUA. Thank you very much, Mr. Thayer, Dr. Kidd, Ms. Tschinkel. We appreciate very much your being here, and your testimony this morning and the responsiveness of your questions.

Thank you very much.

If the audience would like to stand and stretch your legs a minute while our next panel comes up.

[Recess.]

Mr. FUQUA. The committee will be in order. We are very pleased to have our second panel this morning that really deals in the delivery business, and the ones that are really probably more directly involved, are directly involved, let me say, in renewable energy.

Our first witness will be not only a native of this area, but a very distinguished researcher at the University of Florida, Dr. Wayne Smith, to be followed by Dr. Robert San Martin, Deputy Assistant Secretary of Energy for Renewable Energy, and Mr. John Shields, the Director of the Division of Agriculture and Development of the Tennessee Valley Authority.

We will be pleased to make your statements that you have prepared in their entirety part of the record. If you could briefly summarize it, then we will try to get into some questions at the end, I think it will be very, very beneficial.

STATEMENTS OF WAYNE SMITH, DIRECTOR OF THE CENTER FOR BIOMASS ENERGY SYSTEMS OF THE UNIVERSITY OF FLORIDA, INSTITUTE OF FOOD AND AGRICULTURE SCIENCES; DR. ROBERT SAN MARTIN, DEPUTY ASSISTANT SECRETARY OF ENERGY FOR RENEWABLE ENERGY; JOHN SHIELDS, DIRECTOR OF AGRICULTURE AND DEVELOPMENT OF THE TENNESSEE VALLEY AUTHORITY

Mr. SMITH. Thank you, Mr. Chairman.

My name is Wayne Smith, and I am the director of the Center for Biomass Energy Systems of the University of Florida, Institute of Food and Agricultural Sciences.

At the recommendation of the chairman, I will attempt to summarize my remarks and let the more detailed written testimony provided the committee stand for the record.

In my summary, however, I do want to make five points. One is the need for research and development programs for renewable energy technologies;

Two, the need for a consistent Federal policy and program to support and complement that provided by the State and local programs; three, the need to maintain proper balance in those programs; four, to refer to the potential for biomass energy resources to help rural areas such as this five-county region; and finally to point up the fact that those kinds of programs could help other such areas.

Our premise is based on the fact that the future energy supply will probably come from a variety of sources, some of which will be renewable.

The thing that bothers us is that we do not see inexpensive and uninterruptable supplies of petroleum lasting for the future. Yet, at the same time that we are advocating renewable programs, we see an erosion of the support for these types of research efforts.

It seems to us that the support relates largely to the price at the pump. Yet we think that this current worldwide surplus of fossil energy fuel right now relates largely to a world in recession.

Fortunately, we were reminded just a few weeks ago by the International Energy Agency that it appears that there will be another deficit fossil energy situation by the year 1990, and even a crisis situation by the year 2000.

Thus, it is our argument that we should be developing the alternative now without the "cloud of crisis"; and to prevent future attempts to commercialize technologies that are inadequate. And for biomass energy systems, we submit that the technology is inadequate, both in form of crops available as well as the technologies to convert them to useful energy.

Recognizing these inadequacies, the University of Florida initiated a program in 1979 to try to develop biomass energy for Florida.

Florida is especially well suited because we have the climate, as has been pointed out. Our population is growing by 27.8 new residents every hour, and our oil production within this state is declining presently at a rate of about 8 million barrels per year.

We submit that the development of renewable energy is a national need and should be supported by our Federal partner, if for no other reason than it is in the national interest.

However, only modest support for biomass energy has been developed at the Federal level. In fact, this year USDA eliminated all of its special-projects funding for bioenergy, with the exception of a modest amount for alcohol research.

The Department of Energy support at best can be described as uncertain in amount and in program priorities. The deterioration of Federal support for biomass renewables was documented well in the recent report by the Solar Research and Development Panel of the Energy Research Advisory Board, ERAB, as was referred to earlier.

Mr. Chairman, you are to be commended for inviting this report and the Department of Energy is to be commended for selecting Vicki Tschinkel, one of our former panel members here, to chair it.

We hope that the Federal leaders will now use this report to stabilize this situation so that those of us who work as cooperating partners can effectively plan and develop research programs.

I wish to emphasize three points made in that report and suggest that we concur fully with the priorities. One is to develop a comprehensive biomass program. Two is to expand the basic research as it relates to biomass resources development, feedstock crops if you will, and to solve the environmental problems.

We submit also that the conversion technology should be advanced as recommended. I am totally in agreement with the fact that the ERAB assigned not a single aspect of biomass research as a low priority item.

In spite of this careful, considered recommendation of the ERAB panel, the President's budget for 1984 had the priorities reversed. Only $1 million were identified to production research, that is, feedstock crop development, while $16.3 million, which was a reduced budget to begin with, was recommended for conversion, ERAB's second priority. I urge this committee to correct this discrepancy and bring a better balance to the appropriation for biomass research.

Now, the remainder of the program for the ERAB report was well defined there, and I will not repeat them. But I do want to focus on a few points that relate specifically to this five-county or other such rural areas.

First we need to describe the areas, this one in particular. It has a low population density, with more than 90 percent of all of its lands being dedicated to agriculture and forestry enterprises. The proportion of its income largely comes from farming, more than the rest of the State, and the average per capita income is lower than that of the State average.

The area of Florida comprises some of the most fertile lands with abundant water, but yet the agriculture is experiencing hardship conditions. Thus, the area may be described, as is typical of many such areas, as being one with abundant natural resources but with low incomes.

One aspect of this problem is the unavailability of crops that are in demand that can be grown at a profit. American agriculture can easily overproduce many of the crops grown in these five counties.

For example, in the United States, carryover of grains of the type we grow, soybeans, corn and such like, in 1982 are estimated to be 123 million tons—over half of the world's stocks.

Secretary of Agriculture Block recently announced that farmers had signed up to idle 82.3 million acres of land, mostly in corn and other grains. Now, while this may help the farmers in the near term, it does little to help the seed, feritilizer, and feed and farm equipment dealers who are depending on the farmers to farm those 83 million acres for their livelihood.

This situation confirms my contention that we need new crops to provide farm commodities that are in demand and that farmers can grow at a profit. I submit to you that energy crop development is one option that could satisfy this need.

Now, the scientific process for doing that is well developed. Mainly, we need to learn to identify, select, culture, genetically improve, and grow the crops and convert them to useful fuels.

Since we now have the new biotechnologies, recombinant DNA, protoplast fusion, and such like, we believe that the scientific community, given proper support, could make reasonable progress in a very meaningful time span.

Coming back to this five-county area again, wood is an abundant resource. A recent U.S. Forest Service survey revealed that 1.4 million tons of wood could be supplied by this five-county area without reducing the supply of conventional forest products coming off the land.

It turns out, however, that wood, like coal, is not in the desired liquid or gaseous forms. For that reason, we in our institution have developed a program to try to gasify these wood materials to fuel engines, dry grain, protect orchards from cold, and to heat greenhouses.

In this effort, we have made good use of Mr. Harry LaFontaine's expertise gained during his experiences during World War II, and we are continually reminded that while we go along developing these for our current uses, these are very valuable emergency technologies that can be useful should we have the experiences that he has had with closure of borders and interrupted supply.

Now, solving the problem with wood also relies largely on solving the problem of trying to convert cellulose to sugars that can be fermentable to either liquid or gaseous fuels. We and others are rigorously pursuing this approach to try to convert wood to liquid fuels such as alcohol.

For example, should we prove successful, the 1.4 million tons of wood available annually in this five-county area has a potential to yield 56 million gallons of alcohol.

Gasoline consumption in this five-county area in 1982, according to the Governor's Energy Office statistics, was 47 million gallons. Now, whether this alcohol is used for motor fuel or used as a substitute for petrochemicals, as Ms. Tschinkel pointed out, matters little.

But this potential to provide new revenue to this community should be incentive enough to encourage research to solve the conversion problems that prevent utilization of its only reliably available and affordable biomass research resource at this time.

I would be remiss in this testimony if I did not comment on conservation. It has been pointed out by some of our colleagues in the extension service that if you can reduce the energy consumption by 15 percent and keep those dollars in the community, that this oftentimes has better economic return than attracting new industry.

For example, a 15-percent savings in a community of 10,000 generally can amount to an additional 30 jobs, according to that study.

Now, the marketplace of course forces conservation. It is often accompanied by hardship and low productivity. Because of the technical nature of energy and its complex interrelationships with other practices, we believe that considerably more energy can be saved through education and with fewer adverse impacts.

The Cooperative Extension Service exists to provide education programs for a wide variety of audiences. Extension was encour-

aged by the passage of the Energy Extension Act of 1977. With the modest initial funding provided to the Governor's Energy Office, the Florida Cooperative Extension Service helped plan and then initiated a limited program to assist nine Florida counties in targeted programs.

Our hope, like many of the other States, was that the resource would grow and the program could be expanded to include all of Florida counties and to all programs including agriculture.

However, rather than developing energy conservation programs to meet citizens' needs and achieving the national objective of reducing energy dependence, we have been adding trained energy educators to the unemployment roles because funding for the Energy Extension Service has been reduced, as Mr. Thayer pointed out.

We stand ready, if the Congress in their wisdom should choose to fully fund that program, and to work with the Governor's Energy Office in bringing energy extension education programs to the people of Florida.

The need for such improved technology transfer was also pointed out by the ERAB report, and again we stand ready to assist in translating the new technology to consumers.

If I might, I would like to conclude by just summarizing the two points that the Chairman asked us to address. I have discussed what is being done, and what is needed, and I want to summarize my answers to your questions in a few paragraphs.

Most of the underfunded biomass programs that have been initiated with Federal support recently were cut even further. Since I believe it is better to look to the future than to ponder the past, I would like to spend this time now summarizing what is needed.

I have stated that we need a stable, long-term, well-planned research and development program to develop new biomass energy crops that can be grown at a profit. And, two, to develop a conversion technology for transforming the existing abundant woody biomass and new energy crop biomass into the desired useful liquid and gaseous forms.

This five-county area has the land resources well suited to agriculture and forestry, and the people with the desire and ability to grow, harvest and market the biomass for conversion enterprises.

When the necessary conversion technology becomes available, skilled technicians will be needed to staff these facilities. This is an area that can form a model for economic development for many such areas, and I am sure Chipola Junior College stands ready to help train this work force when it is needed.

Similarly, this State's land grant institution, the University of Florida, stands ready to perform its role. We have a long record of successful research in developing new crops and the technology to use them while protecting soil and water resources and environmental quality.

The Extension arm of this system has proven to be highly effective through its education programs, designed to disseminate, and to demonstrate new knowledge from research.

The need for citizens of rural counties to make a decent living is clear. The opportunities to aid this situation and abate the energy

problems have been stated. The institutional and the intellectual commitment by Florida has been made.

We ask this committee, through its leadership, to assure that the Federal Government will respond in carrying its fair share in supporting the research and education programs required to achieve rural economic development by using local renewable energy resources.

Mr. Chairman, I thank you for this opportunity to address this committee on an item that we feel very important.

[The prepared statement of Dr. Smith follows:]

Testimony for
Subcommittee on Energy Development and Applications of the
Science and Technology Committee

Field Hearing: "Rural Economic Development and Energy: What is Needed, What is Being Done"
Chipola Junior College
Marianna, Florida
April 15, 1983

My name is Wayne H. Smith and I am Director of the Center for Biomass Energy Systems in the University of Florida's Institute of Food and Agricultural Sciences (IFAS). The Center has the responsibility for developing biomass energy technology to benefit the people and interests of this state. This technology has value for the nation, other southeastern regions, the state of Florida and especially the counties of Calhoun, Holmes, Jackson, Liberty and Washington.

We believe energy supplies in the future probably will be a mixture, with some coming from a variety of renewable, but site specific, sources. Among renewables, Florida has minimal wind, hydro and geothermal resources but the state has promising potential for direct solar applications (heat and photovoltaic electricity) and for biomass utilization. This potential from biomass exists because of the warm, humid climate and the large array of productive plant species adapted to the range of growth environments that occur in Florida. While these are the sources with strong potentials for Florida, we see them as part of a national mix of renewable energy supplies. Neither this nation nor the rest of the world can continue to be as dependent upon a single dominant energy source as in the past (wood, coal and then

petroleum). Inexpensive and uninterruptable supplies of petroleum and other fossil energy forms cannot be assured in the future. No one denies that fossil energy sources must be finite and exhaustible. Yet, programs designed to develop renewable energy have not been stable and continuous nor focused on long term goals. It appears that support relates to today's "price-at-the-pump."

The current worldwide fossil fuel supply is in surplus mainly because of a world in recession. Someone said, "The best conservationists we have are the unemployed, those in fear of losing their jobs, and managers of closed factories". This situation should not cause us to waver in our commitment. Rather, we should be mindful of factors that should encourage diligent pursuit of renewables. Specifically, I am referring to:

1. Production of oil and gas in Florida peaked in 1978 and has declined every year since (8 million barrels in 1981).
2. Production of oil peaked in the USA in the 1970's.
3. Production of oil worldwide was recently predicted to peak in 1997.
4. Consumption of nearly half of the petroleum discovered to date was consumed in just one century.
5. Reserves and resources (known and expected fossil and nuclear) for energy in the USA could last 320 years; <u>but</u> only 7% occurs as the liquid and gaseous forms desired. The use of these resources <u>must prove to be</u>:

- economically and energetically harvestable and convertible to useful forms, and
- without serious environmental and human health risks.

Fortunately, everyone does not consider the energy problem solved. Recently (during this period of surplus) the International Energy Agency predicted petroleum deficits by 1990 and a serious supply crisis by the turn of the century. Now is the time to develop alternatives through research rather than under a "cloud-of-crisis" where efficiencies are lost and when many fail economically by trying to commercialize inadequate technology.

For biomass energy, the crops available today and the technology to convert them to useful fuels are inadequate. These crops are excellent for the food/feed/fiber purposes for which they were developed during several centuries (intensively through research in the last one), but they are not good energy crops. Production energetics are often unfavorable and the demand for high value uses preclude the efficiencies and the feedstock reliability for developing bioenergy industries. Similarly, conversion technologies available were mainly developed for the spirits and other industries or for waste disposal--not with the efficiencies required for producing cost-competitive bioenergy or petrochemical substitutes.

The University of Florida's Institute of Food and Agricultural Sciences initiated a broad-based program in 1979 to develop biomass energy. Florida is especially well suited because crops

can be selected for year-round production, and Florida has a growing demand for new supplies of energy (the state's population is growing by 27.8 new residents per hour and its oil production is declining 8 million barrels per year). We were fortunate in 1981 to attract support from the Gas Research Institute (GRI) and were able to strengthen the methane from biomass component of our research programs for Florida. Most of the technology we develop will have application to much of the southeast and elsewhere.

Developing such renewable energy is a national need and should be supported by our federal partner if for no other reason than national security (eliminating dependency on imports and supply disruptions). However, only modest support for biomass energy has been developed at the federal level. In fact, this year USDA eliminated all of its special projects funding for bio-energy with the exception of a modest amount for alcohol research. Department of Energy support at best can be described as uncertain in amount and in program priorities. The deterioration of federal support for biomass and renewables was documented well in the report by the Solar Research and Development Panel of the Energy Research Advisory Board (ERAB). You are to be commended, Mr. Chairman, for inviting this report and the Department of Energy made a wise choice by selecting a most capable person, Victoria Tschinkel, of Florida, to chair the panel. We hope that federal leaders will use this report to stabilize the situation so that those of us who work as cooperating partners can effectively plan and develop programs. Both IFAS and our cooperator, GRI, have been frustrated by biomass program reductions in the federal

agencies. These reductions mean that we have to spread our limited resources thinner and thinner to address the many questions awaiting answers through research.

Now I wish to comment on some significant points made by the "blue-ribbon panel of experts" in the ERAB report. We concur that the highest priority aspects are:

1. develop a comprehensive biomass program with clear objectives, priorities and responsibilities;
2. expand basic research on biomass resources (feedstock crops) development; and
3. solve environmental problems associated with biomass technologies.

The second priority, that of advancing conversion technology, is appropriate and research should be encouraged. I totally agree with the fact that the ERAB assigned not a single aspect of biomass research as low priority. The challenge now is to obtain the necessary funding to implement the general program that was outlined.

The specific biomass research steps for developing the required crops and the conversion technology to produce the urgently needed gaseous and liquid energy forms were defined well by ERAB. Therefore, I will comment only to those aspects where the R & D program relates to such areas as this five-county Florida area which is typical of many areas throughout the USA, especially the Southeast.

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First, let's describe the five-county area. The area is:

1. rural with a low population density and more than 90% of all lands used for agriculture or forestry; thus,
2. farm income proportion of total income in these counties is 3 to 10 times the average farm income proportion for the state.
3. The area comprises 6% of the state's land, but includes 10% of the state's forested acreage.
4. The prominent agricultural crops are corn, soybeans, peanuts, pasture for livestock, small grains, and some vegetables, mainly watermelons.
5. The average per capita income for the area is just over half the state average.

This area of Florida comprises some of the most fertile land in the region over an aquifer with abundant water. Yet, agriculture is under hardship conditions. Thus, the area may be described as one with abundant natural resources but with low incomes.

One aspect of the problem is the unavailability of crops that are in demand and can be grown at a profit. American agriculture can easily over-produce many of the crops grown in these five counties. For example, in the USA, carry-over grains in 1982 are estimated to be 123 million tons--over half of the world's stocks. Secretary of Agriculture Block recently announced that farmers had signed up to idle 82.3 million acres--land mostly in corn and other grains--by participation in the Payment in Kind

(PIK) program. While this may help the farmer, it does little for the seed, fertilizer and farm equipment dealers. Peanuts, a crop that is very productive in these counties, is under production control to prevent over-supply. This situation confirms my contention that new crops need development to provide farm commodities that are in demand and can be grown profitably. Energy crop development could satify these needs.

The scientific process for crop development is well known--identify, select, culture, genetically improve and grow. Energy crop development does not have to await the centuries of development that went into the food/feed/fiber crops that we now grow. For example, immediate gains should be possible with peanuts, a crop well adapted to this area, if existing genetic and biochemical technologies were applied to increase its oil yield for use as a diesel fuel substitute. Past efforts have targeted its improvement for its food value. We have available to us the abundant scientific information that evolved over the decades, but we are not limited to this. Also available today are the new biotechnology techniques that could allow quantum steps forward. These technologies include protoplast culture and somatic hybridization, whereby desirable features of unrelated plants can be incorporated into new varieties in ways not possible through conventional sexual reproduction. Showing much promise also are the recombinant DNA techniques that involve the insertion of foreign genes into host organisms and the subsequent expression of those genes. For example, if the gene for either high tempera-

example, if the gene for either high temperature or high alcohol tolerance could be incorporated into the microorganisms that produce alcohol, process efficiency and therefore production cost effectiveness could be greatly improved. These advancements would reduce the energy requirement because the amount of water to be separated from alcohol would be much less and the amount of heat required to distill the alcohol from the water would be reduced. To bring about such improvements, research support is needed to fund the scientist eager to contribute to solving both the energy problem and the agricultural problem.

Wood is abundant in this five-county Florida area. A recent U.S. Forest Service survey revealed that 1.4 million tons of wood per year could be supplied from the five counties without reducing the supply of other forest products. Other forestry professionals have placed the wood availability even higher than the Forest Service estimate; furthermore, they believe fuelwood harvesting would improve the yield of conventional forest species by removing competition. Like coal, wood is not in the desired liquid or gaseous form. A first step is to develop uses of wood in the solid form.

Toward that goal, we initiated a research program to gasify wood to fuel engines, dry grain, protect orchards from cold, and heat greenhouses. For example, a wood fueled heating system for a greenhouse at the IFAS Monticello Research Center required wood costing $175 that replaced LP gas costing $1600. Other work is addressing direct combustion to cure tobacco and provide heat for similar processes.

Solving the problems of converting wood and other lignocellulosics such as cane bagasse into fermentable sugars is essential if these are to be converted into liquids or high BTU gases. The steps usually include size reduction, followed by cellulose/lignin separation (often by steam/pressure explosions), and then the hydrolysis of the celluloses to sugars. The latter step may be accomplished by either acid or enzyme degradation. While both degradations are technically possible, neither is presently economically affordable. We and others are rigorously pursuing research on these two strategies.

Should we be successful, the 1.4 million tons of wood available annually in the five-county Florida area has the potential to yield 56 million gallons of alcohol. Gasoline consumption in the five-county area in 1982 was 47 million gallons. Whether alcohol produced from wood is used as motor fuel or as a petrochemical feedstock matters little. But this potential to provide new revenue to the communities should be incentive enough to encourage research to solve the conversion problems that prevent utilization of our only reliably available, and affordable, biomass feedstock.

Longer-term research should produce new energy crops (trees, grasses, water weeds, and other plants) that can be grown in energy farms to expand the bioenergy industries. It is well known that these industries will not become established until sustainable supplies of feedstocks at stable prices are assured. Corn is an excellent food/feed crop, but it is energetically

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marginal for energy purposes and, due to its nutritional value, will always be captured for food when the supply is not in excess. While surplus food crops can be utilized, an industry cannot be established when prices and supply are as highly variable as those for corn.

Biomass is regionally available and should be addressed in that way. Thus, I was pleased to see the language of the Conference Committee Report for the Appropriations Committee which referred to "regional biomass energy programs". Well planned, regionally focused programs with stable funding could solve problems important to biomass energy that could promote rural economic development. We encourage full funding of this regional approach and stand ready to help all agencies in this region in advancing biomass technology to benefit resource development.

I would be remiss if I did not comment on conservation. To date, farmers and others have been able to survive by practicing conservation. Between 1978 and 1981, overall farming sector energy input prices increased 135% while other input prices increased 55%; farm product prices rose only 22% during the same period. Fuel prices have abated somewhat, but farm product prices have virtually plummeted. Each gallon of fuel saved not only improves profitability but it also keeps dollars in the community. One of our Cooperative Extension Service colleagues in Missouri calculated that a rural community of 10,000 population with an average income could, by decreasing energy consumption by 15%, enjoy a net employment gain of about 30 jobs

over time. He believes that economic development by retention of dollars in the community through conservation often has more promise than attracting new industry.

The market place, of course, forces conservation that is often accompanied by hardship and low productivity. Because of the technical nature of energy and its complex interrelationships with other practices, we believe that considerably more energy can be saved through education, and with fewer adverse impacts. The Cooperative Extension Service exists to provide educational programs for a wide variety of audiences. Extension was encouraged by the passage of the Energy Extension Service Act of 1977. With the modest initial funding provided to the Governor's Energy Office, the Florida Cooperative Extension Service helped plan and then initiated a limited program to assist nine Florida counties in selected target areas. The hope was that resources would grow and the program could be expanded to all Florida counties and all programs including agriculture.

However, rather than developing energy conservation programs to meet citizens' needs and achieving the national objective of reducing energy dependence, we have been adding trained energy educators to the unemployment rolls because funding for the Energy Extension Service has been reduced. Should the Congress see fit to fully fund this program, the Florida Cooperative Extension Service, in cooperation with the Governor's Energy Office, has in place the mechanism for delivery. Extension stands ready to provide assistance to communities so they can be in a position to help themselves.

New technology is emerging from research at a rapid rate. Much of this new knowledge can either facilitate conservation or form the basis for new economic activity. The need for improved technology transfer for the emerging biomass advancements was signaled by the ERAB report. The report recognized relationships between industry and the University Extension Services and suggested that the federal partner should direct more of its technology transfer activities through these channels. We are pleased that the effectiveness of the Extension education process was recognized, and we welcome the opportunity to focus this system on energy programs so that new information is properly disseminated to benefit community economic development.

This five-county area in which you are meeting is a good place to live--if one can make a living. In fact, an IFAS faculty member recently determined, by survey, that 41% of Florida citizens prefer living in a town smaller than 10,000 residents or in the country; an additional 29% preferred to live in communities of 10,000 to 50,000 residents. Thus, there is much interest in rural living. In the same study, over 60% of those preferring rural living opposed the siting of a nuclear facility in their area; nearly half opposed coal power plants, while less than one-third of the people opposed a biomass conversion facility. A large number were undecided about this and other technologies. When people are undecided, educational programs have a role.

Many research programs are now reaching the point where concepts have been proven both for renewable energy such as biomass

and for conservation opportunities. We ask that the Congress not be deflected from a steady course toward these longer term goals that have lasting benefits because of the temporary "oil glut".

I have discussed "What is being done?" and "What is needed?" and I wish to summarize my answers to your questions. Modest, underfunded biomass programs have been initiated and federal support was recently reduced even further. Since I believe it better to look to the future rather than ponder the past, I would rather spend more time summarizing "What is needed?". I have stated that we need a stable, long-term, well-planned research and development program to: 1) develop new biomass energy crops that can be grown at a profit, and 2) develop the conversion technology for transforming the existing abundant woody biomass and the new energy crop biomass into the desired, useful liquid and gaseous forms. The five-county area has land resources well-suited to agriculture and forestry and people with desire and ability to grow, harvest, and market the biomass for conversion enterprises. When the necessary conversion technology becomes available, skilled technicians will be needed to staff these facilities. This is an area that could form a model for economic development for many such areas, and I am sure Chipola Junior College stands ready to help train this work force when it is needed.

Similarly, this State's Land Grant institution, the University of Florida, stands ready to execute its role. We have a long record of successful research in developing new crops and the technology to use them while protecting soil and water re-

sources and environmental quality. The Extension arm of this system has proven to be highly effective through its educational programs designed to disseminate and demonstrate new knowledge from research to all interested groups.

The need for citizens of rural communities to make a decent living is clear; the opportunities to aid this situation and abate the energy problem have been stated; the institutional and intellectual commitment by Florida has been made. We ask this committee through its leadership to assure that the federal government will respond by carrying its "fair share" in supporting the research and education programs required to achieve rural economic development by using local renewable energy resources.

I thank you for the opportunity to address this committee on such an important topic.

PERSONAL DATA

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Work experience:

July 1981 to Present - Technical Manager, Gas Research Institute/Institute of Food and Agricultural Sciences, "Methane from Biomass and Waste".

June 1980 to Present - Director, Center for Biomass Energy Systems, Institute of Food and Agricultural Sciences; University of Florida.

August 1978 to Present - Director, Center for Environmental and Natural Resources Programs, Institute of Food and Agricultural Sciences, University of Florida.

April 1978 to 1980 - Principal Investigator, Biomass and Chemicals from Woody Plants in Florida. Department of Energy Funded.

July 1976 to August 1978 - Assistant Director for Forestry (Management, Biology, and Products) and Professor for Forest Nutrition, School of Forest Resources and Conservation (SFRC), University of Florida.

February 1976 to 1979 - Co-Leader of the Intensive Management Practices Assessment Center (IMPAC), a US Forest Service - University of Florida - Forest Industry research program to study the effects of intensive management on multiple forest values.

1968 to 1977 - Co-Coordinator of the Cooperative Research in Forest Fertilization Program (CRIFF), a University of Florida - forest industry research program which studies soil, plant relations as they relate to forest fertilization.

September 1973 to August 1974 - Forest Biologist, Cooperative State Research Service, Washington, D.C. (while on faculty development leave).

July 1971 to July 1976- Assistant Director for Research and Associate Professor, SFRC, UF.

1964 to 1971 - Assistant Professor, SFRC, UF.

1960 to 1964 - NDEA Research Fellow and Teaching Assistant, Mississippi State University.

Summer 1963 - NSF Research Participant, North Carolina State University.

Summers 1958, 1959, and 1960 - Technical Aid, U.S.D.A. Forest Service.

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Mr. FUQUA. Thank you very much, Dr. Smith.

We are very happy to have Dr. Bob San Martin, who has some ties to Florida as Deputy Assistant Secretary of Energy.

Bob, we are very happy to have you here.

Dr. SAN MARTIN. Thank you, Mr. Chairman. I thank you for the pleasure of appearing before this committee again, and even more than that, I thank you for the opportunity for allowing me to return to my home State of Florida.

I wish to discuss with you today renewable energy technologies and the opportunities these technologies offer to the rural community.

As Deputy Assistant Secretary for Renewable Energy in the Department of Energy, it is my responsibility to manage the activities of the renewable energy program, which includes active and passive solar energy, solar thermal programs, wind energy, photovoltaics, biomass energy, ocean energy, geothermal energy, and low-head hydro power.

Solar and other renewable energies are very diversified in the energy types which they can provide. They can be used for heating; they can be used for cooling. They can be used to produce electricity. They can be used to produce high-temperature heat sources for industry, and you can also use these energy resources to produce gaseous liquid fuels and solid fuels.

Solar energy by its nature is dispersed. It is regionally specific, but it is clearly available throughout this Nation in one form or another.

I believe that the successful development and continued implementation of solar and renewable energy technologies will further enhance the support of diversifying the energy supply base for this country. I believe it can help stabilize the cost of energy that is

available for our citizens, and can also enhance employment opportunities throughout the country.

We have a relatively short history in the modern development of renewable energy, basically the last decade, but during this time there have been extension advances in technical information and innovation. This has been reflected in many areas.

Some solar technology, such as photovoltaics, has experienced over a 100-fold reduction in the cost of the products, resulting in several applications in this country and internationally that are cost effective today. This growth of knowledge over the last decade has increased application opportunities.

We also see developing throughout the Nation a rather significant industrial base that can support the further development of solar and renewable products and their sales and implementation.

I was speaking recently to officials from the Solar Energy Industries Association who were informing me that a poll of their membership indicates that over the last decade that the solar industries in particular have sold over $8 billion worth of solar energy products in this country. In fact, some of the statistics I have been looking at recently indicate that solar is growing at a very fast rate. In fact, in 1982, there were sales of almost $2 billion worth of solar products throughout this country.

This is one of the fastest growing industries that we have. I believe that the Department of Energy Renewable Energy Program is particularly relevant to the Florida agricultural activities for two basic reasons.

First, agriculture, food production and processing industries are major energy consumers. A recent study indicates that 12 to 15 percent of the gross U.S. demand for energy is used to provide food.

Second, previous and current Department of Energy research and development activities continue to provide opportunities which can be used by the agricultural sector to decrease their dependency on fossil fuel. We will continue to focus our programs on research and development, and we will depend very strongly on the private sector for the implementation of these new ideas.

However, in implementing and proposing these programs, we do maintain an awareness of how the results of our research efforts are being used by the commercial interests. In addition, we maintain and support significant technology transfer programs, so that individuals who are interested in not only what might be currently available, but what the future may hold, have a place where they can go for this type of information.

Mr. Chairman, instead of going through a long discussion of the individual renewable technologies, and the improvements that have occurred in each, I would just like to conclude by saying that I believe strongly that the dispersed nature of the energy needs in rural areas, combined many times with their generally higher costs, suggest that rural applications will offer even greater near-term opportunities for renewable energy technologies.

I believe that our Federal research and development program is providing new knowledge and technical advances required to maintain the momentum for the development of these renewable energy applications. Our long-term commitment to research and development excellence is providing a sound technological base, which is

allowing the private sector to assume market development responsibilities for the most promising technologies.

Even today, renewable energy technologies in this country provide almost 5 percent of our national energy needs. That is a very significant number.

There remain many challenges in realizing the benefits of these renewable technology options, but I must also strongly state that we have many opportunities available to us today in applying them.

I personally have great confidence in our Nation's innovative agricultural community, our industrial base, and our free market system, but most of all, I have confidence in the entrepreneurial and pioneering spirit which is the backbone of the greatness of this country.

Mr. Chairman, this concludes my formal statement. I would be pleased to respond to any questions after the panel comments.

[The prepared statement of Dr. San Martin follows:]

PREPARED STATEMENT OF ROBERT L. SAN MARTIN

Mr. Chairman and Members of the Subcommittee:

Thank you for this opportunity to appear before you today to discuss renewable energy technologies and the opportunities for these technologies in the rural community. As the Deputy Assistant Secretary for Renewable Energy in the Department of Energy, it is my responsibility to manage the activities of the Renewable Energy Program, which includes active and passive solar energy, solar thermal, wind, photovoltaics, biomass, ocean thermal, geothermal energy, and low-head hydropower.

It is my intent today to briefly describe the activities of the Federal renewable energy program and to give examples of the contributions that renewables can make to meet the energy needs of rural communities, especially the agricultural sector. The DOE Renewable Energy Program is particularly relevant to Florida's agricultural activities for two basic reasons. First, agriculture and food processing industries are major energy consumers. A recent study indicates that 12 to 15 percent of the gross U.S. demand for energy is used to provide food. Second, previous and current DOE research and development activities continue to provide opportunities which can be used by the agricultural sector to decrease their dependency on fossil fuels.

The DOE program focuses on research and development activities and, as such, depends on the private sector for the implementation of these new ideas. However, we do maintain an awareness of how the results of our research efforts are being used by commercial interests. For individuals interested in the results of DOE supported research, we maintain a technology transfer program that provides this information in a concise and understandable format.

DOE PROGRAM OVERVIEW

The DOE Renewable Energy Program is part of a balanced energy strategy that recognizes the need for the development of a full range of energy technologies

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which compete in a free market environment. In this context, the Federal effort supports a long-term commitment to fundamental scientific and engineering research which can lead to a better understanding of today's renewable energy technologies and maintain the momentum necessary for the development of new renewable technology concepts. Our programs are designed to bring renewable energy technologies to a point where private sector interests can continue to develop, refine and apply the results of this research with their own investment capital.

The potential benefits of the Federal renewable energy program activities for the State of Florida are significant. The State is fortunate to have resource characteristics that favor a diverse mix of renewable resource options. These characteristics include an abundance of solar insolation necessary for solar heat and photovoltaic technologies; a lengthy growing season that encourages utilization of biomass; and coastal winds that present opportunities for the development of wind power.

As the Federal role focuses on advancements in renewable technologies, and the private sector carries on market development responsibilities, potential system users in Florida will be able to select among the competing and available energy alternatives. This energy mix is important because a majority of Florida's current energy demand is being supplied by petroleum and natural gas fuel resources imported into the State. A balanced energy mix is precisely the focus of the DOE program. I would like to now briefly describe some of the R&D activities within the program.

RENEWABLE ENERGY FOR RURAL APPLICATIONS

Renewable energy encompasses several conversion technologies and many system options and applications. Several of these technologies can be applied to meet agricultural and rural energy needs.

Biomass is one of the more significant renewable energy resources available

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to agriculture. Wood, animal waste, crop residues, and other organic matter are all capable of being converted to some form of energy with available state-of-the-art technologies.

One example of such a system is located in Bartow, Florida. This DOE-industry cost-shared project, located on a 10,000 head beef cattle feedlot, involved the development of an anaerobic digester which converts up to 25 tons of manure per day into biogas and a protein-rich feed ingredient. The gas is piped to an adjacent meat packing plant where it is co-fired with oil in a boiler.

The Department's biomass program is encouraging the use of biomass energy in the agricultural sector. There is a need to increase the supply of available feedstocks without adversely affecting the supplies of food and fiber required for other purposes and to improve the yield from feedstocks for conversion into liquid and gaseous fuels and petrochemical substitutes at competitive prices. For the Northwest Florida region, this can involve consideration of crops such as peanuts for an energy feedstock. We are currently participating in a cost-shared research project studying the on-farm handling, storage and conversion of peanuts into a diesel fuel substitute. An on-farm wood chip gasifier project is also being supported by the DOE at the University of Florida. The unit uses wood and crop wastes such as peanut hulls to produce a gaseous fuel which can be substituted for propane and diesel fuels.

Florida has a diverse biomass resource base, and the Federal program is continuing R&D efforts to identify various biomass options, some of which will have applications in Florida. Projects include the feasibility of using native woody species for short rotation production; analysis of marine aglae; and a study of hydrogen production by tropical marine photosynthetic bacteria.

The quality of Florida's solar insolation combined with its energy use patterns has provided excellent opportunities for the results of DOE solar energy research and development activities to be brought forward to the marketplace by private

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sector interests. Applications such as hot water heating and space cooling consume a large share of the State's end-use energy demand. In this area, the DOE R&D program is addressing advanced concepts and collector materials development for solar collectors and windows. Low cost, high performance materials are being identified and tested to advance the state-of-the-art of active and passive heating and cooling technology.

A recent analysis conducted by the Florida Solar Energy Center on collector performance reported a 33 percent increase in efficiency for collectors evaluated in Florida between 1977 and 1981. The increase in performance was attributed to improved collector design and materials. Current R&D supported by the DOE program will continue to improve the prospects for the solar collector industry to refine systems and to increase the opportunities for additional solar heating and cooling applications. Expansion of the collector market will augment the Florida collector manufacturing industry, already established as one of the nation's leaders in terms of collector production.

Photovoltaic energy is another renewable energy source capable of supplying energy to rural residents. Photovoltaics is the direct conversion of light into electrical power. The DOE program is examining methods of reducing photovoltaic system costs through the use of low cost materials while maintaining maximum cell efficiencies. One project of significant interest to the agricultural community is our current effort to test and evaluate an on-farm photovoltaics system which supplies electricity for irrigation, crop drying, and fertilizer manufacturing.

Wind power also provides another renewable energy option well suited to the needs of rural communities. In Florida, the coastal areas, including the northwestern panhandle coast, exhibit wind resource characteristics suitable for power production. Research and development activities sponsored by DOE have resulted in improved wind machines that helped foster the growing small wind machine

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industry. As a result, there are numerous examples of wind facilities and wind farms in the planning or development stage which are sponsored by private sector groups. Six small wind facilities in Florida have received funding from DOE.

STATE AND FEDERAL COOPERATION

The development of renewable energy products cannot depend solely on Federal R&D. The resources and talents of State and local governments, the business community, and private citizens are necessary to provide the support and innovation needed to allow the acceptance and use of renewable energy technologies.

Florida is recognized as one of the leaders in solar energy development. The State has established the Florida Solar Energy Center in Cape Canaveral which serves as the nucleus of Florida's solar energy effort. The objective of the Center is to research, develop, report, transfer, and implement projects that will lead as rapidly as possible to the utilization of solar energy in Florida. The Department recently awarded $2 million to the Center to establish it as one of the three centers in the U.S. for testing residential application of photovoltaics. The Southeastern Residential Photovoltaics Environment Station will test systems under Florida's climatic conditions as well as monitor photovoltaic systems in the other southeastern states. We are also encouraged by the involvement of private businesses in the demonstration of renewable energy applications for Florida citizens. In Tallahassee, Florida's first completely solar-powered medical facility will be operational this year. The facility will receive electricity from a stand-alone photovoltaic power system which is being financed entirely by private investment.

The Florida legislature has also passed several important solar laws, including the exemption of solar systems from property and sales taxes. These types of incentives at the state level complement available Federal incentives such as residential and business solar energy tax credits.

CONCLUSION

The generally dispersed nature of energy needs in rural areas, combined with their higher cost, suggests that rural applications will offer near-term opportunities for renewable technologies. The balanced Federal R&D program in renewable energy is providing new knowledge and technical advances required to maintain the momentum for the development of renewable energy applications. Our long-term commitment to R&D excellence is providing a sound technological base which is allowing the private sector to assume market development responsibilities for the most promising applications.

Mr. Chairman, this concludes my formal statement. I would be pleased to respond to any questions that either you or the other members of the Subcommittee may have regarding the Department's efforts in renewable energy development.

Mr. FUQUA. Thank you very much, Dr. San Martin. We appreciate your being here.

Mr. FUQUA. Mr. Shields?

Mr. SHIELDS. Thank you, Mr. Chairman. It is a pleasure for me, on behalf of the Tennessee Valley Authority, to testify before this committee.

When we speak of rural America and talk about family farms and small farms, I come from a region, and am with an organization that sits in the midst of one of the most rural areas in the United States.

Consequently, the work that we are doing in terms of energy, especially renewable energy research and development, must take into account the resources that family farmers can access.

Before I discuss the work that we are doing in energy related to rural and economic development, I would like to comment on what some of the panelists before me have mentioned—the use of petrochemicals in herbicides, pesticides, and fertilizers.

The National Fertilizer Development is at the cutting edge of fertilizer technology, research and development. One of the largest programs we have had in the last 5 years has been to try and find an alternative method to produce ammonia, which is a main source of nitrogen fertilizers in this country. Consequently, we have been involved in a later large ammonia from coal technology development project.

We are on the verge of having this technology ready for commercialization. It is a joint venture with the Texaco Corp. and has a real potential for lessening our independence on natural gas for ammonia production. Now, let me briefly comment and highlight some of the things that we are doing, which are, at the cutting edge of the energy work. The panelists before me have covered the topic well. I will probably say nothing new, other than to inform this committee of what programs TVA has in place.

In the biomass area, we have a project in which we produce 190-proof ethanol from wood. The Tennessee Valley is, of course, over

50 percent wooded. It is estimated that roughly 30 million tons of hardwoods go to waste every year, and this hardwood could be converted to usable energy.

If this waste could be converted into liquid fuel, it could conceivably produce most of the gasoline that would be necessary to run the farm tractors and farm machinery in the Tennessee Valley region—a region that covers parts of seven States.

Another project is in cooperation with the Department of Energy—as are many of our energy projects—and I do want to say that with respect to the Department of Energy, they have provided not only funding, which I think obviously everyone recognizes, Mr. Chairman, but I would like, while Mr. San Martin is sitting to my right, to give DOE credit in that they do have good technicians that have participated in the development of this technology with us, giving a lot of technical guidance.

We have a 10-gallon per hour pilot plant (alcohol still) on the reservation at TVA, in which we are making ethanol from a number of different crops. One fact we must consider carefully in the Tennessee Valley region is that many of the energy type crops that we will need to grow have not traditionally been grown there.

Therefore, we must consider nonconventional crops. We have been doing this through research, looking for crops that could substitute for the traditional crops.

We have, produced 190 proof ethanol from corn, sugar cane, Jerusalem artichokes, okra, etc. We are only at the very beginning of this research and development.

We are now looking at modifying our plant—again, in cooperation with DOE—to produce ethanol from nonwoody cellulosic materials, crop residues, heavy forages, hays, etc. We feel that there is a real need for a low-heat acid hydrolysis process to convert these cellulose materials into sugar, which is the base from which we need to start this work.

We have been doing some work with vegetable oils, not as much as we have with ethanols, mainly because many of the crops other than soybeans are not native to our area.

In fact, the researchers are having some difficulty growing crops, such as sunflowers, which doesn't produce well in the Tennessee Valley region. However, there are other potential crops.

We are involved in conversion of animal manures and crop residues to biogas (anaerobic fermentation). We have contracts at the present time with several farmers and we are using swine manures, poultry waste, also municipal sludge.

This work, is in cooperation not only with a local municipality in the private sector, but it is always in cooperation with a university—in most cases, a land grant university, the experimental station or the Extension Service. This is the delivery system by which most of our technology is delivered to American agriculture.

Eighty percent of the electrical energy in this country generally is derived from steam-powered technology. Thirty-five to 40 percent of that ends up as electricity; the rest goes away as waste heat. At the Brown's Ferry TVA nuclear plant, the waste heat has been harnessed and is now being used as a result of a greenhouse project we started 5 years ago. Three different greenhouse complexes covering an acre were developed, and this past year we were able to

22-639 O - 83 - 9

lease the greenhouse to a commercial grower to grow ornamentals and vegetables.

To this point, we are very pleased with the development of that technology. In fact, we as an agency are putting very little money into that technology at the present time.

Everything that has been said about solar this morning someone in TVA, either in our division or in the office of power, is probably involved in. We ourselves have some work trying to develop solar technology for greenhouses, crop drying and for use in swine and poultry houses.

North Alabama, particularly the eastern part has a large poultry industry, and there are producers who are using solar energy to generate their power.

I need not say more about the commercialization and industrialization use of wood, solar ponds, photovoltaics, municipal animal wastes, hydro. All of these things have been covered, and I could not comment on them any better.

I would like to comment briefly, though, about the future and echo some of the things that have been said.

First, I must second what Dr. Smith said about research in the biomass area. It should be continued, and in fact has to be, to improve the basic technologies, including the development, the identification of more efficient bacteria yeast or other organisms for producing fuel such as biogas, alcohols, improved processes for converting lower value feedstocks, depremium fuels and identifying higher value uses of byproducts from alcohol.

I would also like to add that the economic viability of these technologies is a major hurdle because of the high investment cost required for most biomass fuel systems. Conventional fuel prices are still less expensive than biomass-derived fuels.

Lower interest rates, higher relative escalation rates for conventional fuels and Federal and State tax incentives will make the use of biomass-derived fuels more feasible, but it is very difficult to predict the actual effect of these variables over time, and especially their impact on small farmers in rural America.

Attention must be given to economics in the early stages of research and development. An economic analysis should be used to identify process steps or components having the greatest effects on overall cost.

Now, I am not saying that economics should dictate the technology. Obviously, we know that as technology develops, the economics gets better, but it can serve as a sorting ground for these different technologies.

A point that I think is very important that I would like to make to this panel is it would not be wise to depend on any one source alone. I think a mix of all of these technologies must be prudently pursued.

Moreover, we must continue to encourage efficient use and energy conservation wherever feasible. Incentives should be offered to producers and users of renewable energy sources offering the most potential.

Agriculture, with a track record as being one of the most efficient producers in the U.S. economy, should not be viewed alone as a feed, food, and fiber producer, and as an energy producer, but

also should be challenged as a future renewable energy producer. I firmly believe that.

A final point that I would like to make is that congressional committees, in considering the 1983 fiscal year budget, specified the need for DOE to establish regional biomass centers. I certainly believe that regional approaches to developing underutilized resources for biomass are warranted, because biomass resources differ geographically.

The southern region has strong biomass potential because of the relative warm climate, high rainfall combined with lands and forest which are not presently used to their potential. I certainly would like to add emphasis to the regional concept.

I would like to conclude by saying, Mr. Chairman, I hope I have not left the impression that we do this technology alone, because I think that Ms. Tschinkel had a very important point, and that is that this is really a big ball game; it is a big ball park, and a lot of people are involved in this technology.

There is tremendous opportunity for sharing this technology, both from the standpoint of the knowledge and also from the standpoint of the cost. No one organization, I believe, possesses all of the necessary capabilities and expertise that it takes to be an expert in all areas of these renewable energies.

We at TVA are glad to be a part of it.

Mr. Chairman these are my brief remarks. I have submitted the full text of my testimony for the record.

[The prepared statement of Mr. Shields follows:]

Committee on Science and Technology
U.S. House of Representatives
Subcommittee on Energy Development and Application
Field Hearing on "Energy and Rural Development: What is Needed and What is Being Done."
April 15, 1983
Chipola Junior College
Marianna, Florida

Testimony of John T. Shields, Director of Agricultural Development, National Fertilizer Development Center, TVA, Muscle Shoals, Alabama

Introduction

Mr. Chairman, I appreciate the opportunity to participate in this field hearing on energy and rural development. I will comment on energy needs in rural America, discuss programs TVA is conducting to develop alternative energy sources for agriculture and other uses, and provide references for additional reading about potential alternative energy sources.

First, I would like to give you a brief overview of the purpose of the TVA National Fertilizer Development Center (NFDC), and to establish why we are involved in energy research and development.

The National Fertilizer Development Center at Muscle Shoals, Alabama, is the Nation's only institution conducting a significant R&D program to create new and improved fertilizer products and more efficient methods for making them. It is one of the big factors in America's agricultural success story.

The NFDC, operated by the Tennessee Valley Authority, is the primary source of new fertilizer technology. Most fertilizers used by American farmers today are made with the aid of developments from Muscle Shoals.

In terms of commercialization of research, the TVA Fertilizer Center is without equal. There are two good reasons for this: (1) The research has a strong practical orientation, and (2) implementation gets as much emphasis as creation.

TVA-developed processes are used throughout the commercial fertilizer industry. Hundreds of industry representatives travel to Muscle Shoals each year to learn of the latest advances and to solicit help on specific problems. In addition to following research progress, the industry buys experimental fertilizers from TVA for testing and introduction in its own systems. TVA engineers and field staff also work closely with university specialists and members of the industry to promote adoption of new technology. All of this speeds market development. Once a new product is established and demand for it is being met by commercial producers, TVA curbs its output and shifts emphasis to other areas.

Thus, the TVA Fertilizer Center is very much a part of America's feed, food, and fiber production processes. We pride ourselves on being one of the best-fed nations in the world. We have high-quality food for our citizens. We export huge amounts to others. And although some Americans complain about high food costs, the fact is that food remains a bargain relative to what citizens of other nations pay for food.

Fertilizer is an unsung hero of this success story. Scientists estimate that 35 to 45 percent of the gain in food production over the past 20 to 30 years is due directly to better and more efficient use of fertilizers. The NFDC has been the motivating force behind the advances in fertilizer technology and use in recent decades.

The NFDC is a "melting pot" opportunity for research chemists, chemical engineers, agronomists, economists, and educators. They work in laboratories, greenhouses, pilot plants, and prototype production facilities to develop improved fertilizer technology. Then they work alongside university specialists, industry leaders, and others to achieve commercialization of practical new knowledge and get the benefits of research to farmers, agribusinesses, and consumers.

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In recent years R&D activities of the NFDC have been oriented to reducing the amount of energy required to produce fertilizers. Major recent developments include the pipe reactor for making fluid fertilizers and the pipe-cross reactor for making granular fertilizers. These processes use the heat of chemical reaction to replace the heat normally supplied by fossil fuels to concentrate fluids or to dry granules.

Research is also underway to produce ammonia from coal gas and to increase efficiency of applied fertilizers. These and other R&D activities are helping reduce fossil fuel requirements in producing fertilizer.

The staff expertise and R&D facility capability of TVA have also been applied in recent years to developing alternative energy sources for the family farmer. Agriculture of the future may well be an energy producer as well as a feed, food, and fiber producer.

Energy for Agriculture

Energy is essential to food and fiber production and there must be reliable and economic fuel sources for farmers.

Energy use in the U.S. for food production, processing, distribution, and preparation amounts to about 16 percent of the total U.S. annual energy consumption of 80 quadrillion (Quads) Btu, while production agriculture accounts for only about 3 percent of total U.S. energy use (1, 2, 3, 4). By comparison, the amount of energy used for onfarm production is less than the amount used by our country's commercial jet aircraft (2). Even though the amount of energy used in agriculture is relatively small, no other use is more critical in terms of our national wellbeing.

Energy in production agriculture is used for manufacturing chemical fertilizers and pesticides, vehicular power for field operations and transportation, stationary mechanical power for irrigation and materials

handling, heat for crop drying and facilities heating, and manufacturing machinery and other purchased inputs. Much more energy is used directly for crop production than for livestock production; in 1978, 1.8 Quads was used for crop production and 0.2 Quads for livestock production (2). The largest single agricultural energy use is for the production of fertilizer and pesticides; about 0.7 Quads annually, primarily from natural gas.

Energy for agricultural production operations generally can be categorized by the form of energy used, but there is some crossover among use categories. Vehicles use about 3.5 billion gallons each of gasoline and diesel fuel annually for field operations and transportation, which accounts for about 55 percent of onfarm energy use (2).

Energy for crop irrigation requires 20 percent of the onfarm energy used, and is provided by natural gas, LP gas, and other liquid fuels. Another 12 percent is used in livestock, dairy, and poultry production, and is supplied primarily by LP and natural gas and electricity. Eight percent of onfarm energy use is for crop drying and curing, and is supplied by LP and natural gas and electricity. The remaining 5 percent of onfarm energy use is represented in purchased inputs and other miscellaneous uses (2).

Meeting Farm Energy Needs with Biomass

The different types of energy needed for agricultural production theoretically can be supplied with biomass, but all such uses may not be practical. Technologies for many of these uses of biomass are currently available and considerable research and development activities are underway on a worldwide basis to refine biomass technologies and improve practicality and economics of use. From an onfarm energy perspective, biomass derived energy can be categorized by potential use.

Vehicular power for field operations and transportation requires transportable, high-energy content liquid fuels that can be used in available equipment or with minimum modification. Such premium fuels are available from biomass and include alcohols and vegetable oil derived fuels. Ethanol, methanol, and butanol are some of the alcohols being considered; ethanol at the present time is the most likely alcohol for onfarm production and use.

Stationary mechanical power can be obtained by combustion of premium liquid fuels. However, since equipment mobility is not a constraint, several other biomass sources can be used for these type applications. Biogas, or methane, from anaerobic digestion of animal wastes or plant materials can be used to fuel internal combustion engines. Thermochemical gasification of plant material can also provide low-Btu gas for internal combustion engines. Direct combustion of biomass can provide steam for space and process heating, mechanical power, or for electricity production. Similarly, biogas or other fluid fuels can be used to generate electricity for mechanical power.

Energy for facility heating, crop drying, and other process heat applications can be obtained from any biomass energy sources previously mentioned or, more simply, by direct combustion of biomass. Cogeneration can be used to produce electricity and then the waste heat can also be used in some cases for other applications such as process space heating.

Direct combustion of crop residues or other biomass could also be used on farms to produce steam for process heat, mechanical power, or electricity. Steam-driven farm equipment was extensively used, especially for large threshing machines, prior to our technological shift to petroleum fuels for farm equipment. However, it is unlikely that steam driven equipment of this type will again be practical in the foreseeable future.

Similarly, other thermochemical biomass conversion processes, such as the conversion of biomass to hydrocarbon-like fuels through reactions at high temperatures and pressures, require very large capital investments and are much better suited for industrial scale operations than for farm-scale use (5).

TVA's Biomass R&D Program

In late 1980, TVA organized a biomass fuels program which is managed through TVA's National Fertilizer Development Center in Muscle Shoals, Alabama. The program offers potential for use of vast underutilized biomass resources for fuel energy. TVA's major emphasis is on the development of more efficient technology for converting hardwoods to alcohol. Other areas receiving considerable attention include development of technology to produce alcohol from selected farm crops, crop residues and direct-combustion of wood, and other technologies. Let's look at these in more detail.

Hardwood Fuels Research

Thrust is on developing an efficient and economical process for converting hardwood to ethanol. About 30 years ago TVA and USDA's Forest Products Laboratory jointly developed an acid hydrolysis process which is presently being used to convert wood to ethanol in Russia. Now, TVA researchers are working on methods that would make the acid hydrolysis process substantially more efficient. Equipment for this research has been installed at Muscle Shoals and progress toward a more efficient system has been made in the laboratory.

More than half of the Tennessee Valley is in forests. Eighty percent of it is hardwoods. Only about one-third of annual hardwood growth is harvested, and stumpage prices are depressed. Estimates indicate that the Tennessee Valley alone could supply more than 30 million tons (dry weight) of surplus hardwood per year for energy.

If the entire 30 million tons of this unused resource could be converted to ethanol by a successful process, about 35 to 40 percent of the 4 billion gallons of gasoline annually used in the Valley could be displaced. A more plausible possibility would be to use about half of the wood for ethanol production and hence displace about 20 percent of the gasoline used in the Valley. The remaining half of the wood could then replace about one-third of the natural gas used for heat and steam in commerce and industry.

The full use of the hardwoods resource for energy would create a need for new plants and new jobs and spur economical development especially in rural areas. For example, if all the wood available for energy use were to be used to make ethanol, about 30,000 new jobs would be created in the Valley and the total economic impact would be about $500 million per year from a renewable resource.

Alcohol Fuels From Crops

Industrial technologies for ethanol production are well established; however, as many farmers have discovered in the last few years, technologies for economical farm-scale systems are not well established.

Although 'moonshine' production is a well established art, conversion of crops to ethanol at consistently high yields in an energy-efficient and economic production system is quite complex.

TVA, in cooperation with the Department of Energy, has developed an energy efficient farm scale unit that can be constructed by the farmer. Construction and operating guidelines for several different size units with production ranging from 6 to 50 gallons of 190-proof ethanol per hour are being developed.

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TVA's present unit produces 10 gallons per hour of 190-proof ethanol. Alcohol has been made from such crops as corn, potatoes, sweet sorghum, grain sorghum, water chestnuts, and crop culls.

We are also studying the fuel-producing capability of several other crops including Jerusalem artichokes and sugar beets. TVA tested 13 nontraditional energy crops on test plots last year to determine their suitability for Tennessee Valley conditions.

TVA also has a major effort underway, in cooperation with the Department of Energy, to develop a process for converting nonwoody cellulosic materials into ethanol. Crop residues and high-yielding forage crops are the primary feedstocks of interest. Emphasis is on developing a low-temperature acid-hydrolysis process to convert the cellulosic materials into fermentable sugars. Technologies are being developed that are suited to relatively small-scale alcohol plants (1 to 2 Mg/y capacity) that could be located in agricultural areas and effectively use cellulosic material from surrounding farms.

The existing 10 gallon-per-hour facility will be modified to include the acid-hydrolysis process developed in order to allow testing concepts in an actual facility.

Most of the Valley's land available for cropping is already being used; but an estimated 2 million acres of marginal underutilized land is suitable for growing fuel crops (17). With proper conservation measures such as minimum tillage and multiple cropping, it may be possible to use some of the more steeper, more productive marginal lands for fuel crops. We are identifying land resource areas with considerable percentages of these kinds of land.

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The Extension agents in the region have also been consulted to get their assessment of farmer interest in energy crops.

Vegetable Oil Fuels

Onfarm production and processing of vegetable oils as a diesel fuel substitute or supplement have received considerable research attention within the last few years (6). Oils from sunflowers, soybeans, rape, and other oil crops have properties similar to diesel fuel, and short-term tests have shown potential for using these oils in diesel engines. Vegetable oil esters have shown even greater potential as a fuel, and good performance results have been obtained with diesel engines.

Technical problems identified with vegetable oil fuels include excessive carbon and gum deposits, injector fouling, increased engine wear, and lubrication oil fouling. These problems continue to be researched. It was concluded at the 1982 International Conference on Plant and Vegetable Oil Fuels, held at Fargo, North Dakota, that most crude degummed vegetable oils, burned either directly or as a mixture with diesel fuel, appear to be suitable for use in diesel engines with precombustion chambers. It was also generally concluded that methyl and ethyl esters of vegetable oils, either directly or as a mixture with diesel fuel, were suitable for use in diesel engines without precombustion chambers.

Small-scale oil extraction equipment has been developed, and investment costs are generally much lower than for the other biomass technologies previously discussed. Processes for oil extraction and filtering are also straightforward, but extraction efficiencies may be lower with farm-scale equipment than with industrial equipment. A byproduct cake is obtained with farm oil extraction, and has value as a feed ingredient.

Technologies for using vegetable-oil-derived fuels are rapidly becoming available. Tests by universities and equipment companies are providing valuable engine wear and other use data, and vegetable oil fuel use is highly likely should diesel fuel not be available.

However, vegetable oil crops are currently worth 2 to 3 times as much for food as for fuel, and, until this price gap narrows or reverses, it is not likely that significant substitution for diesel fuel will occur.

TVA has conducted a limited amount of research on producing vegetable oils for fuels and is continuing to monitor technology development.

In research plots at TVA, sunflowers and okra have produced sufficient seed to produce more oil than a 50-bushel-per-acre soybean crop. Soybean yields in north Alabama are typically about 25 bushels per acre. Sunflowers appear to be amenable to double cropping. Very little research has been carried out on okra. One research opportunity with okra is to identify shatter resistant varieties for the indeterminant fruiting plant so that seeds from the lower pods do not lose seed while the top portion of the plant is still flowering. The meal remaining after extraction of oil from both sunflowers and okra is a high quality protein feed worth about $200 per ton as animal feed.

Direct Combustion Gasification

Farm-scale technologies are available for direct combustion of wood, wood residues, and crop residues to provide process heat for uses such as crop dyring and space heating. Commercial wood- or residue-fired furnaces are available in most areas of the country, but initial system costs are normally much higher than for conventional oil or gas-fired units of similar capacity.

Farm-scale gasifiers designed specifically for grain drying are being researched at several universities (7, 8, 9, 10, 11). Most of these systems are two-stage gasifier-combustion designs that are capable of producing a clean, hot exhaust suitable for crop drying without requiring heat exchangers.

The initial cost for these systems is substantially higher than for conventional gas-fired equipment, and the economics of use is highly dependent on the collection and storage cost of the biomass fuel and the amount of time the system is used. However, there are farm situations where direct combustion or combustion/gasification systems are both technically and economically feasible, and the use of these systems has potential to increase as commercial units and biomass harvesting and storage systems become more available. Fluidized-bed technology has also been researched for both direct combustion and gasification of biomass. In a fluidized-bed reactor, a bed material such as refractory sand is fluidized by combustion air injected under pressure, and a rapid and uniform combustion of the fuel occurs within the bed. Gasification appears to be better suited to fluidized bed technology than does direct combustion (12).

TVA has identified 175 potential locations for direct combustion of wood, with 65 feasibility studies completed and several units under construction. Demonstrations have also been given on the latest wood harvesting technologies.

Biogas

Conversion of animal manures and crop residues to biogas through anaerobic fermentation has also received considerable research attention (13, 7, 14, 15, 16). Technologies are available for biogas production, and such systems are extensively used in Asia, particularly in China.

Most research efforts have focused on lowering investment and operational costs, improving gas production rates, and integrating gas production with on-farm uses.

Animal wastes from confined facilities such as beef cattle or swine feedlots, are the most common biogas feedstocks, as they are continuously available and anaerobic digestion can also accomplish some waste treatment. A sludge byproduct is produced which can be used as an animal feed ingredient, bedding, or fertilizer. Such use generally improves overall system economics, depending on the sludge processing required.

The biogas produced normally contains about 55 to 70 percent methane, 30 to 45 percent carbon dioxide, and traces of hydrogen sulfide and water vapor. The gas cannot be readily liquified, thus storage is a major problem. Since biogas is produced continuously and storage is expensive, systems that can use gas continuously offer greatest potential. The most efficient biogas use would be direct combustion for heat. Farm energy demands for crop drying, facility heating, and irrigation are suited to biogas from a technical standpoint, as biogas is a suitable fuel for direct combustion for heat and for fueling internal combustion engines. However, these demands are very intermittent and system economics is severely hampered if these type uses are not incorporated into a continuous use concept.

TVA engineers are working with a farmer on a biogas project using swine waste from a 40-sow farrowing-to-finish operation. The farmer built the facility of readily available materials for a cash outlay of less than $4,000. Biogas made in the facility replaces LP gas in three broiler houses. TVA is also providing technical assistance to AID to assist in establishing and implementing a bioenergy program to help less developed countries.

Waste Heat Utilization Potential

For over a decade, TVA has been investigating the use of "waste heat" from power plants or other industry for the purpose of heating greenhouses or livestock facilities, soil heating and irrigation, growing fish, and recycling livestock waste. More than 80 percent of the electrical energy produced in the U.S. is generated by power plants utilizing steam-power technology. With this technology, only 35 to 40 percent of the energy from the fuel consumed by these power plants eventually ends up as electricity, with the remaining 60 to 65 percent lost to the environment as waste heat.

Typically, such waste heat is embodied in the large quantities of cooling water necessary to condense the steam in power generation facilities. Results of our work show that potential benefits of waste heat use are great, but there are a number of hurdles to be overcome in its development. These include: (1) developing waste heat parks which are attractive to potential users of the waste heat, (2) selecting and modifying existing production technology and developing new technology where needed, and (3) developing overall production systems which are economically efficient. TVA plans to proceed with onfarm commercialization of waste heat as fast as funds will allow. TVA research in using power plant waste heat for greenhouse heating culminated in the construvtion and operation of a one-half acre test and demonstration facility at the Browns Ferry Power Plant.

TVA has now leased the Browns Ferry Greenhouse to a commercial producer. Heated water from the nuclear plant is used to heat the greenhouse which can produce vegetables or ornamental plants.

A waste heat tie-in has been made at the new TVA Watts Bar Nuclear Power plant for future commercial waste heat use. TVA is currently researching alternative ways of pricing the waste heat.

This work can be tied back to alcohol production with the carbon dioxide from an alcohol plant used to supplement a greenhouse environment. A representative from Archer Daniel Midlands came to see TVA's waste heat greenhouse prior to their building a greenhouse adjacent to their alcohol production facility.

Solar Energy Applications

Another promising energy source for the U.S. is direct use of solar energy. This energy source is particularly promising for agricultural production uses that require large quantities of low-temperature heat such as drying crops, heating livestock facilities, and heating greenhouses. Agricultural solar systems are often used intermittently and we believe must be low-cost and practical if they are to be economical for most on-farm needs. TVA--as well as many others--is attempting to develop solar use technology for onfarm drying of crops, heating livestock facilities, and heating greenhouses.

Crop-drying activities in the U.S. use about 12 percent of total energy consumption used in crop production. About 60 percent of the total drying energy is used for drying corn--followed by tobacco, soybeans, rice, peanuts, and sorghum. This indicates a great potential and we will continue to study the technology and economics of solar crop drying.

We are also working with a greenhouse grower to construct and operate a commercial solar-heated greenhouse. TVA provided the system design and has shared in the cost of materials. We will assist in evaluating the engineering technology, energy use, crop production, and economic performance of the solar energy systems.

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Other work includes onfarm solar heated swine and poultry facilities. Use of solar energy in these systems has a good potential in many areas of the U.S., especially if the solar systems can be primarily minor modifications to standard building designs, such as substituting a fiberglass-covered collector for a galvanized roof on a poultry house.

In addition to work being conducted at the National Fertilizer Development Center, TVA's Solar Application Branch is involved in extensive solar energy research and application. Highlights of this work follow.

Solar Energy Overview*

Introduction

In the search for inexpensive and abundant energy, TVA has looked to the sun for practical ways to help Tennessee Valley residents conserve their resources.

To meet the diverse energy needs of the Valley, TVA has developed programs that encompass the broad range of solar applications. Passive solar homes, conventional and modular, have been designed and demonstrated. Thousands of solar water heaters have been installed in Memphis and Nashville-Middle Tennessee. Solar-assisted home improvements such as sunspaces and solar wall heaters have been encouraged.

TVA is working with power distributors to make a wider range of energy efficient home improvements available for more consumers through The Energy Package. This innovative approach provides surveys for a variety of solar and energy conservation measures and financing with no-interest or low-interest loans. Under The Energy Package, many of the demonstration programs offered originally in a limited number of cities have been expanded to include all interested distributors of TVA power.

*Energy Applications Branch, Office of Power, Tennessee Valley Authority, Chattanooga, Tennessee

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In hand with providing design assistance for commercial and industrial solar applications, TVA is also demonstrating solar applications in its own buildings, such as the large office complex under construction in Chattanooga.

Since the benefits of the sun can also be gained indirectly, TVA is encouraging the use of renewable resources. Efficient ways to use wood in homes and industry are being applied. An investigation of wind energy is progressing with TVA's first test wind energy system in Tennessee. Solar-powered electricity generation through photoelectric cells and solar ponds is being pursued. And to assist the public more directly, a solar information service has been established to make expert advice on solar technologies available throughout the Valley.

Conservation of resources, savings in the costs of providing electricity in the future, energy self-sufficency--individually and nationally--and protection of the environment are the compelling reasons TVA is exploring the use of solar energy. A more detailed look at TVA's solar energy activities follows.

Solar Energy for Homeowners

In New Homes--Since energy use in the home accounts for a significant portion of the Valley's electrical consumption, TVA aggressively promotes construction of energy-efficient homes that incorporate solar features.

TVA initiated this effort in 1977 with the Solar Homes for the Valley Project, a program that encouraged the use of passive, or nonmechanical, solar features in conventionally built homes. Demonstrating that passive solar designs can be practical and effective, 35 homes were designed and built that collect and use solar heat in a variety of ways. Among these

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methods were skylights, south-facing windows, attached greenhouses, Trombe walls, and water walls. While building passive solar features into these homes cost slightly more per square foot than comparable conventional homes, the solar energy features reduce annual electricity use approximately 5,400 kilowatthours.

The TVA Energy Saver Home Program, started in late 1981, provides building standards for the construction of energy-efficient homes. Through this program, TVA is working with Valley home builders to help them develop an energy-efficient building package that includes conservation and solar options.

Qualifying new homes built under this program are awarded an Energy Saver Home medallion to identify them to the home-buying public. Energy Saver Homes that include energy-reducing solar options, such as a solar water heater, sunspaces, or a direct gain system, are awarded bonus points to reflect the added energy efficiency of the homes.

TVA is also turning to home designers and builders to gather even more ideas about possible uses for solar energy in new homes through the Passive Solar Homes Portfolio Project. Under this project, 100 passive solar home designs are being compiled for distribution to consumers to make it even easier for Valley residents to put the sun's free energy to work in new homes.

In Existing Homes--A consumer does not have to build a new home to benefit from solar energy. Once a consumer has weatherized an existing home for maximum energy savings, energy remodeling, or retrofitting, is possible. If the home is suitably located and space is available, retrofitting can include passive solar measures such as sunspaces, additional south-facing windows, solar wall heaters, movable insulation, and shading.

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In Nashville, 300 Nashville Electric Service customers have the opportunity to install passive solar retrofits in a TVA pilot project. Participants get a free solar audit, do-it-yourself information, recommendations for suitable retrofits, inspection of the installations, and low-interest loans. The savings from passive solar retrofits depend on the measure chosen and may range from about 900 kilowatthours a year for landscape shading to 3,800 kilowatthours a year for a sunspace.

Information gathered from this project will be used to determine the cost effectiveness of passive solar retrofits for the consumer and to measure consumer acceptance of the retrofit measures.

In Greeneville, Tennessee, the public haousing authority was awarded funds by the U.S. Department of Housing and Urban Development to test new ways to cut energy costs in public housing. Over 250 public housing units were retrofitted for passive solar space heating and cooling. TVA provided technical expertise for design and quality control and is monitoring retrofit performance.

In Water Heating--One of TVA's earliest solar retrofit demonstrations was the Solar Water Heating Program. Previously available only in Memphis, Nashville, and Middle Tennessee, the program is now offered under The Energy Package through participating distributors Valley-wide. Qualified consumers receive free solar surveys of their homes, loans to purchase and install solar water heaters, and free installation inspections.

More than 3,000 Valley residents have taken advantage of the program, and TVA estimates participants may reduce the amount of electricity used for water heating by 40 to 80 percent.

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Solar Energy for Commerce and Industry

In Water Heating--Solar water heating is also being offered as a practical option to large and small firms and institutions in the Tennessee Valley through the Commercial and Industrial Solar Water Heating Project. Installations of up to 35 solar water heating systems throughout the region are planned.

The program is designed to obtain market research and development information and to evaluate possibilities for wide-scale applications. Commercial water heating systems installed under the program can reduce annual electrical use for water heating by 35 to 55 percent.

Participating firms and institutions receive financial and technical assistance from TVA for the design, purchase, and installation of the systems. The large solar water heating systems appeal to restaurants, schools, hotels, multi-unit housing facilities, hospitals, laundries, beauty shops, and to other consumers that use large volumes of hot water.

In Building Design--Passive solar applications may also be possible for the existing 93,000 commercial buildings in the TVA service area and the approximately 2,000 new ones built each year. To help ensure these buildings use solar energy wherever possible, TVA offers technical and design assistance through the Commercial and Industrial Passive Solar Buildings Program. This assistance is provided individually and through seminars and workshops to owners, investors, building designers, and contractors.

Design guidelines also are being developed on the basis of generic building types and will be available for 20 different building categories when the program is completed. The guidelines will include energy-related criteria that can be incorporated into the normal design process of the Valley's commercial, industrial, and institutional consumers.

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In TVA Facilities--To further promote conservation and demonstrate the use of solar energy, TVA is using solar applications in its own facilities in new and renovated buildings if the energy saved will pay for the installation.

The majority of the TVA solar facilities projects are used for heating and cooling buildings and heating water. Some however, are used for lighting, producing electricity, and recording water levels near dams and powerhouses.

The new Chattanooga solar office complex, for example, makes maximum use of sunlight for natural daylighting. Windows near the ceilings of the five- and six-story units will allow sunlight to hit reflectors that will direct the light inside the building. Glass-covered areas between pairs of buildings also will admit sunlight for lighting and passive heating, and waste heat from computers will be harnessed for winter heating.

Promising Technologies

Dispersed Power

To encourage technologies consumers may use to produce electricity, TVA has developed a Dispersed Power Program. Electricity production from such renewable energy sources as wind, wood, solar ponds, photovoltaics, micro-hydro, and municipal and animal wastes is being explored, and ways to make such production cost effective are being examined. TVA expects to show, for example, that its experimental solar pond in Chattanooga, a man-made pond filled with heavy salt water solution, can trap and return up to four billion Btus of solar heat annually for commercial use.

In addition to TVA initiatives, the program provides a market for electricity produced by the region's small power production facilities, both to help make dispersed power cost effective and to see if such power can be economically channeled into the TVA power system. Attractive standby

power charges and technical assistance to potential cogenerators are offered. Already, TVA has completed contracts to purchase power from five industrial firms in Tennessee.

Photovoltaics

One of the more complex applications of solar energy for electric generation involves photovoltaic systems. These systems use silicon cells that convert the sun's energy to electricity. The potential for this form of energy is unlimited.

In an effort to make the systems available to the general public and reduce the Nation's use of fossil fuel, the U.S. Department of Energy established the Federal Photovoltaic Utilization Program. Under this program, TVA is conducting the largest residential photovoltaic experiment by a public utility in the Southeast. The purpose of the project is to test the systems, evaluate their potential, and measure their performance.

Today's rapidly expanding photovoltaics technology indicates that production of photovoltaic cells is likely to become an economical and practical way for consumers to apply the sun's free energy for residential use within another decade.

Livestock and Municipal Wastes

Waste from livestock and municipal sewage systems is being used to supply nutrients for growing aquatic crops that can be used as livestock feed, human food, or for biomass fuel. Tests with sheep indicated that Duckweed, water chestnuts, and water chestnut hay are suitable feedstuffs for ruminant animals.

Researchers are growing tilapia (a tropical fish) and freshwater shrimp together in ponds fertilized with chicken manure. The use of

warm water from the TVA Browns Ferry Nuclear Plant has been shown to stimulate early spawning, allowing production of Tilapia fingerlings 75 days earlier in the growing season than usual. This early spawning can allow production of a marketable-sized fish in one growing season instead of the two seasons normally required.

Wind Energy

To tap all of the Valley's alternative energy resources, TVA is exploring the potential of wind power to generate electricity. Studies have shown that the Valley areas which offer the greatest opportunity for wind energy are the mountainous areas of eastern Tennessee, northern Georgia, western North Carolina, and southern Virginia.

Measurements are being taken in those areas where wind energy potential is the greatest. For testing and demonstration purposes, TVA will purchase and install small wind turbines--modern windmills that can generate electricity. TVA has installed its first 50-kilowatt turbine at a site in the Bald Mountains near Greeneville, Tennessee. It is expected to generate electricity at a cost of 7.5 to 10 cents per kilowatthour.

In the near future, wind measurement equipment will be made available on loan to consumers and local electric utility companies so they can assess the potential for using wind energy on their sites. Small wind turbines for residential consumers may cost $7,000 to $10,000 and should produce electricity at a cost of 10 to 15 cents per kilowatthour.

Wood for Residential Use

The indirect use of the sun's energy in a renewable resource, such as wood, is another sensible way to help consumers reduce their use of electric energy.

Wood heating systems are another service offered under The Energy Package. Distributors in environmentally acceptable areas of the Valley may offer consumers loans to buy and install efficient, safety-listed wood heaters. As part of the emphasis on safety, free inspections of heating system installations are performed.

Studies show that airtight, efficient wood heaters can save residential consumers 40 to 65 percent on electric heating bills, reduce demand for electric power, and help consumers use an economical, renewable energy source.

Wood for Commerce and Industry

To promote the use of wood in commerce and industry, TVA's Commercial and Industrial Biomass Program provides information and education for industry officials, architects, and engineers who design commercial heating systems and industrial energy systems used in the region.

Technical assistance and limited financial incentives are offered to selected participants to encourage the demonstration of innovative applications.

Solar Information Service

With the development of a wide range of new energy-saving programs to benefit consumers, questions about alternative energy resources abound. TVA's Solar Information Service (SIS) helps Valley consumers answer their questions and become involved in the energy decisions which directly shape their future.

In each of TVA's seven district offices, experienced solar educators answer questions, give presentations, and hold workshops where consumers may actually build solar devices being discussed. More than 250,000 people throughout the Valley have been reached by the efforts of the SIS in its first two years of operation. Topics presented ranged from the

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general--"What is Solar Energy?" and "Solar in New Homes"--to the specific, such as "Do-It-Yourself Solar," "Sunspaces," and "Solar Water Heating." Additionally, solar information resource materials are available at the district offices, including brochures, factsheets, slide shows, and films.

Catalog of Conservation and Solar Publications

A valuable tool, free for the asking, the "Catalog of Conservation & Solar Publications," lists many booklets, brochures, factsheets, plans, and other publications consumers may request to learn how to use and conserve energy.

The "do-it-yourself" and "how-to" books available through the catalog give step-by-step instructions for constructing solar devices and fully weatherizing homes. Information on specific TVA energy conservation programs as well as general information on home energy conservation, energy-efficient new homes, solar energy, and elimination of energy waste in commercial and industrial buildings is also available through the catalog.

The Future

We have briefly discussed the current sources and uses of energy for agricultural production, some more likely biomass energy substitutions, along with solar energy, and identified TVA's work. The major question now is, "What research and development is needed before these systems can be implemented on farms?" Better equipment is needed along with reliable performance documentation. Basic process technologies are available for most energy related uses of biomass, at least sufficient to allow adequate equipment and process designs. Operating experience, especially in an R&D setting, will lead to better equipment selection and performance.

Attention should be given to feedstock collection, processing and storage, and also to byproduct and waste handling and disposal. Similarly, long-term environmental effects, both specific to the farm and to the environment in general, need to be assessed. Information developed should be made available to potential equipment and technology suppliers and to farmers in an easily understood manner. Better information is needed on biomass energy system operation and maintenance.

Research should be continued to improve basic technologies, including development or identification of more efficient bacteria, yeasts, or other organisms for producing fuels such as biogas and alcohols, improved processes for converting lower value feedstocks to premium fuels, and identifying higher value uses for byproducts from alcohol, vegetable oil, and biogas production. Improved biomass crop yields with lower input energy and costs also should be investigated.

Economic viability is a major hurdle because high investment costs are required for most biomass fuel systems. Also, conventional fuel prices are still less expensive than biomass-derived fuels. Lower interest rates, higher relative escalation rates for conventional fuels, and Federal and State tax incentives will make the use of biomass-derived fuels more feasible; but it is very difficult to predict the actual effect of these variables over time.

Attention should be given to economics during early stages of research and equipment development, and economic analyses should be used to identify process steps or components having greatest effects on overall costs. However, current economic situations should not alone dictate research and development efforts for biomass fuels.

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Since petroleum fuels are a finite resource and since agriculture is critically dependent on premium liquid fuels and natural gas, it is likely that most of the biomass energy technologies we have observed will be widely implemented on farms in the future, possibly within the next decade. The rate of implementation will depend on the cost and efficiency of the technologies available as compared with cost of other fuels, and this is difficult to predict.

Direct combustion or combustion and gasification systems appear to be the most feasible biomass use when available resources are properly integrated with specific energy needs. In areas of high electricity costs, biogas for electricity production and supplemental heat looks promising. The economic success of onfarm alcohol production will be heavily dependent on sale of excess farm-produced alcohol fuels for non-farm use. Likewise, the onfarm processing and use of vegetable oil fuels is highly dependent on non-farm value of both the oil and of diesel fuel.

Technologies are available for onfarm production and use of biomass energy. Improvement of these technologies will occur with time. Sufficient biomass resources could be available on farms to supply a substantial amount of agricultural production energy and a small amount of our nation's energy. Prices farmers receive for agricultural products are low compared with prices for most farm inputs, especially energy. This should provide an incentive for onfarm biomass energy use to reduce energy costs. Equipment and processes are becoming available for biomass energy use, but onfarm implementation is slow due to a lack of reliable information for farmers to use in assessing their particular resources as related to biomass energy.

The U.S. is blessed with a wide range of energy options for the future. It would not be wise to depend on any one source alone. Moreover, we must continue to encourage efficient energy use and energy conservation wherever feasible. Incentives should be offered to producers and users of renewable energy sources offering the most potential. Agriculture, with a track record as being one of the most efficient producers of the U.S. economy, should not be viewed alone as a feed, food and fiber producer, and as an energy user but also should be challenged as a future renewable energy producer.

I would like to make a final point relating to the TVA biomass program. Congressional committees in considering the 1983 fiscal year budget specified the need for DOE to establish regional biomass centers. TVA is being considered as a regional center. I believe regional approaches to developing underutilized resources for biomass are warranted because biomass resources differ geographically. The southern region has strong biomass potential because of the relatively warm climate and high rainfall combined with lands and forests which are not presently used to their potential. A regional approach with long-term planning and continuity of funding could provide a valuable impetus toward improved use of resources, decentralized energy production, more energy independence, and rural economic development.

Thank you again Mr. Chairman, for this opportunity to testify at your hearing.

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ENERGY AND RURAL ECONOMIC DEVELOPMENT

Many of TVA's community and economic development programs have an energy focus.

1. Ridesharing Technical Assistance--To help its employees conserve fuel used in commuting, TVA has established the Nation's largest bus and van pool operation. Based on this experience, TVA provides technical assistance to industries and communities within the Valley region interested in establishing their own ridesharing programs.

   According to the President's 1979 Rural Development Initiatives Report, many rural residents face extreme difficulties in gaining access to jobs, health care, social services, and recreation activities because of the lack of adequate transportation services. On the average, rural residents have a longer travel distance to employment locations than their urban counterparts. With public and private alternative modes of transportation virtually nonexistent, rural residents face real economic hardship because of the increased cost associated with transportation. An effective ridesharing program can play an important role in reducing transportation costs for rural residents. In addition to the cost savings to participants, ridesharing reduces pollution and traffic congestion and saves fuel. One vanpool saves 5,000 gallons of fuel annually, removes 6 tons of pollutants from the air, and removes 10 cars from the congested roadways.

2. Energy Conservation--As one element of its comprehensive technical assistance program for existing businesses and industry, TVA conducts

comprehensive energy audits and makes specific recommendations for conserving energy in all aspects of each individual business's or industry's operation. This helps to increase the economic viability of the businesses that receive the services.

3. Community Energy Management Demonstrations--Placing dimensions on the energy problems and identifying specific courses of action to manage energy resources is difficult, if not impossible, for most small communities. To demonstrate solutions to this problem, TVA assisted DeKalb County, Alabama; Watauga County, North Carolina; Tupelo, Mississippi; and Lincoln County and Norris, Tennessee, to establish community energy management programs. TVA helped the communities to organize for action and to develop specific plans to address energy problems and opportunities in the transportation, industrial, residential, commercial, public, and agricultural sectors. Potential savings through community energy management are huge. For example, if all of the actions identified in the DeKalb County, Alabama, "Energy Management Plan" were implemented, local savings would amount to $8 million per year in 1982 dollars.

4. Water, Wastewater, and Solid Waste--TVA provides assistance to Valley water systems in water conservation. We have found that some rural water systems are losing as much as 70 percent of their water through leakage which represents a substantial energy cost for treatment and pumping the unused water. TVA has 10 units of water leak detection equipment which it loans to small communities at no cost. We also train local operators to use the equipment. This program is very

effective. For example, in Spring City, Tennessee (population 1,700), operation of the local waterplant was reduced from 24 hours per day to 8 hours per day after locating and repairing leaks.

TVA also provides technical assistance to rural communities designed to help them improve their solid waste management practices. For example, the convenience center concept of rural collection (developed by TVA) simultaneously provides an avenue for employing untrained youth or individuals on a fixed income, reducing fuel usage for county vehicles, and allowing the collection of source-separated materials for recycling. Recycling brings additional energy-saving benefits to industries. Assistance and demonstration projects that involve wastes as resources each have their own peculiar types of energy-conserving impact, whether it be (1) a system that converts waste into steam and electricity in Sumner County, Tennessee; (2) the application of sewage sludge as a substitute source of fertilizer in Florence, Alabama; or (3) a landfill designed from scratch to recover methane gas in Hamilton County, Tennessee.

5. Energy-Conserving, Affordable House--Housing-related energy costs represent a major outlay to most rural residents. TVA architects have designed a low-cost, 1,130-square-foot energy-efficient house which can be constructed for less than $30,000 (lot included). The first unit, constructed by the Woodland Land Trust in rural Campbell County, Tennessee, will be dedicated on Sunday, April 17, 1983. The house uses prefabricated wooden trusses for the floors, walls, and roof and is

mounted on jacks for easy foundation construction and leveling of the structure. The structure is heavily insulated (R-30 ceiling/R-19 walls and floors) and can use either a wood stove or an energy-efficient heat pump for heating.

6. Energy Impact Analysis--As a result of its involvement in a multibillion-dollar nuclear plant construction program, TVA has developed techniques for identifying, measuring, monitoring, and mitigating the impacts of major energy-related construction projects on the communities in the vicinity of its major projects. Effective approaches have been developed for handling the temporary impacts of the worker influx on transportation and education systems, fire protection and law enforcement, public utilities, housing, and other government services.

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JOHN T. SHIELDS

John Shields has been with TVA since 1965, serving as Economist and later as Administrator of the International Fertilizer Development Staff. In that position he was responsible for directing and coordinating the transfer of TVA fertilizer technology to foreign countries. He has directed technical assistance missions in over 30 countries; serves as advisor to FAO, UNIDO, and The World Bank; and is on several U.S. Government industry advisory boards on food, fertilizer, and agriculture.

As Director of the Division of Agricultural Development since 1981, Mr. Shields is responsible for directing TVA's national fertilizer research and technology program with the fertilizer industry and universities. He is also responsible for the agricultural resource development functions of TVA.

John Shields holds B.S. and M.S. degrees from the University of Kentucky with post graduate work at North Carolina State University and Cornell. He is author and contributor of numerous publications on world fertilizer production, marketing, use, and economic development.

He is a member of several professional organizations and is active in community affairs. He and his wife Jan have three children--Larry, Patricia, and Craig--and reside at 326 Flurnoy Avenue, Florence, Alabama.

Mr. FUQUA. Thank you very much, Mr. Shields.

Dr. San Martin, Mr. Shields mentioned the regional biomass centers, and there was about $4 million appropriated in the fiscal year 1983 continuing resolution for that.

Do you know what has been the disposition of that? What the position of the Department is on those centers?

Dr. SAN MARTIN. Mr. Chairman, our position is that we concur that this is a good idea. We are implementing the direction of Congress in that regard.

We have funded the Northwest regional activity, which had been a continuing program before this particular appropriation. We are now at the last part of completing the internal planning for implementing the program, and will be going forth first, in my opinion, with implementing the regional program in the Southeast, which includes this area. Then we will be implementing a portion of the program that will cover the Northeast and northern tier States that have considerable biomass resources.

We expect these to all be underway before the end of this fiscal year. With regards to the South and Southeast aspects, we expect those to be underway within the next 30 to 45 days.

Mr. FUQUA. Very good.

Dr. Smith, you mentioned the ERAB report, the Energy Research Advisory Board, commonly referred to as the ERAB report. I might say that this subcommittee, in marking up the DOE authorization bill for fiscal year 1984, basically followed those recommendations, particularly as it relates to renewable energy sources. So I think we generally followed along the lines of those recommendations in the appropriations that were contained in the fiscal year 1983 budget.

Now, that will still be coming up before the full committee, but it has generally bipartisan support to restore quite a few of those funds that had been omitted by the OMB this time.

Mr. SMITH. I certainly salute you for doing that; because I think you have taken a real substantive step toward aiding the cause of biomass. That footing is very solid, and one that I think we can guide on for a number of years.

Mr. FUQUA. I just want to comment on one of the statements Mr. Shields made, and that is of an energy mix. Nuclear can play a very important role; coal can play an important role; solar can play an important role. They all have a role, but in many cases, no single one is going to be the solution to the problem, and I concur wholeheartedly.

There are certain parts of the country—we are very fortunate in this area that biomass has been pointed out as a very readily available renewable source of energy. We also have a lot of sunshine most of the time, but we are a long way from coal.

I mean coal has to be transported over long distances, but many areas where wind, geothermal, many various forms of energy can be utilized. I think it behooves this country in its long-range strategic planning to try to develop as many of those sources as we possibly can where they have unique characteristics to various geographic areas of the country.

Solar may not work well in Wisconsin. Other forms of energy may work better. But in even some of the mountain States, Colora-

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do and some of those, solar homes work very, very well. Each one has a particular thing and maybe even wind is a strong potential in some parts. It is not maybe in this particular area of Florida.

So I want to commend you on that. I think that is a very excellent statement.

Mr. Sensenbrenner?

Mr. SENSENBRENNER. In the interest of time, I have no questions, Mr. Chairman.

Mr. FUQUA. Mr. Lewis?

Mr. LEWIS. I have just one question of Mr. Smith, Mr. Chairman.

Does the University of Florida or any other universities that you are affiliated with or in correspondence with work toward and actively support contracts and R&D agreements with the private sector?

Mr. SMITH. Absolutely. I could say that just about all that I am familiar with do that. Of course we do, and I can speak more knowledgeably about our own situation.

I would signal in our own biomass research effort that our State of Florida made a commitment to support biomass research through its legislative action in 1979, and this attracted the attention of the Gas Research Institute, which is in the private sector. Realizing that resources were limited for both parties, they make a significant contribution to our programs, so, now we are enjoying that synergism. We get about 2 million a year.

Mr. LEWIS. What percentage of that is your R&D budget for energy, approximately?

Mr. SMITH. Well, that becomes a matter of definition. If you are asking what percentage that is, of our alternate energy budget within the institute—that is not speaking to the work of photovoltaics that goes on in our college of engineering and elsewhere because I am not familiar with the numbers there—but in our case, it would probably be somewhere in the neighborhood of about 40 percent of our alternate energy research program.

Now, that is not of our total energy program, because that would include the things that Dr. Kidd talked about like the production of nitrogenfixing plants, the integrated management and biological pest control procedures, to reduce the input of fertilizers and pesticides in those kinds of energy-consuming activities, and in agricultural production of the usual commodities, those are different activities than our alternative energy program.

Mr. LEWIS. Thank you.

Mr. FUQUA. Thank you, Mr. Lewis.

As we bring this to a close, I want to thank my colleagues, Congressman Nelson, Congressman Sensenbrenner, and Congressman Lewis, for being here today. I think it has been very helpful.

I want to thank our witnesses that have made presentations to us. They have been very good.

I couldn't go without thanking the exhibitors who have really supported this science fair and conference that we have. I want to thank you very much for being here. I plan to visit the exhibits this afternoon.

I want to thank the steering committee for all the work that you have done. For almost a year you have been working on this conference, and this has kind of been the culmination of it. I want to

particularly thank Dr. Richburg and the faculty and the students, and all those associated with Chipola Junior College for letting us use your facilities, but more so for the contributions that you have made and the leadership.

We thank you.

I turn the program over to you, Dr. Richburg.

And, for the reporter, the committee has adjourned.

[Whereupon, the subcommittee adjourned.]

APPENDIX

ADDITIONAL STATEMENTS SUBMITTED FOR THE RECORD

Illinois Department of Transportation
Division of Aeronautics
One Langhorne Bond Drive/Capital Airport
Springfield, Illinois/62706

ILLINOIS DEPARTMENT OF TRANSPORTATION
DIVISION OF AERONAUTICS

RESEARCH ON ETHANOL FUEL FOR AIRCRAFT ENGINES

My name is Larry Matt and I am the Chief of the Bureau of Maintenance in the Illinois Department of Transportation, Division of Aeronautics. I would like to express the appreciation of the Division for inviting us to testify before you today on our project to study the feasibility of ethanol fuel for light aircraft. We flew an ethanol-fueled Cessna from Springfield, Illinois to be here today.

The Division of Aeronautics is proposing to undertake a multi-phase study to add to the research concerning the feasibility of ethanol for an aircraft fuel. Ethanol appears to be an excellent alternative to petroleum-based fuels for aircraft for the following reasons:

- It is a renewable fuel resource.
- It is relatively cool burning, conducive to longer engine life.
- It produces relatively lower levels of exhaust pollutants.
- It enables lower operating costs.
- It may permit reduced production costs for aircraft turbine engines, due to its cool burning characteristics.

In addition, ethanol can be produced from grains and other biodegradable materials. The use of ethanol for aircraft fuel can thus create a significant new market for agricultural commodities and help reduce our nation's dependence on foreign imported oil.

At present, the Division is pursuing a three phase research program described below.

Phase I We are currently test flying an ethanol-powered aircraft for altitude and long range performance. The Division is flying a Cessna 182 with a Continental O-470 engine, using 190 proof ethanol as fuel, with only minor modifications. The cost of materials was not significant and three hours of labor were required for the conversion of the engine. Based on our experience, the power output flight characteristics and endurance are equivalent to gasoline. Our flight to Marianna, Florida, is part of this program to prove the range reliance of the fuel.

Phase II A 150 hour engine test cell run on ethanol will be conducted by a leading Illinois university. The data from this research is required by the Federal Aviation Administration prior to issuance of a Supplemental Type Certificate for ethanol as an aviation fuel.

Phase III We propose to make additional modifications to a gasoline aircraft engine to increase its performance with ethanol fuel. With the assistance of several professors of aviation and engineering and using new ideas in high energy engines and ignitions, we will seek to produce an aircraft engine that will more efficiently utilize the properties of ethanol. We are confident that the engine will surpass the performance of gasoline. The engine will be modified at an Illinois college and will be operational within a year.

At present, the Illinois Department of Transportation, Division of Aeronautics, operates seven turbine-powered aircraft. We feel that ethanol, mixed with one or two percent of either corn or soybean oil additive to act as a top lube, could be an alternate fuel for turbine or jet engines.

The Division would like to undertake research on alternate turbine fuels, using a small turbine engine such as a PT6-41, manufactured by Pratt Whitney, or any other PT-6 series engine. We would like to use that particular engine since it is used in the aircraft in our air fleet. The Division could only pursue this research if it could acquire the engine at little or no cost, such as through the U. S. Army which presently flies King Air 200's using the PT6-41. It is hoped that an engine could be given or loaned to the State of Illinois for the research and development program. After the State's testing of the turbine engine, it would be desirable to conduct flight tests on a turbine-powered aircraft. Such an aircraft could possibly be obtained at no cost, such as through a loan from the U. S. Department of Drug Enforcement from its inventory of confiscated aircraft.

If the Division can promptly secure these item and funding for the research operations, it could accelerate research and make the information available to the aviation industry much sooner. Our program has been constrainted due to State budgetary considerations, causing us to rely on donations of fuel and equipment from interested ethanol producers, aviation enthusiasts and other state agencies.

Again, let me say that I am happy to be here today on behalf of the Division of Aeronautics. If you desire further information regarding our research program on ethanol fuel for aircraft, please contact Robert L. Donahue, Director, Division of Aeronautics, at One Longhorne Bond Drive, Capital Airport, Springfield, Illinois 62706, telephone 217/753-4400.

WRITTEN TESTIMONY
To The

Subcommittee on Energy Development and Applications, Committee on Science and Technology, U.S. House of Representatives, Marianna, Florida, April 15, 1983.

Mr. Chairman, I am Bill Holmberg of Falls Church, Virginia. This testimony is submitted on behalf of the following individuals and organizations that participated in the 4 E Conference held in Marianna, Florida, April 14-16, 1983. These pioneers are at the cutting edge of their respective technologies. They are:

Bill Paynter

President, Union Flights, Sacramento, California
Alcohol fuels in aviation. Modified a company aircraft and piloted a transcontinental flight on methanol.

Dr. Max Shauck

President, Flight Research, Inc., Waco, Texas
Alcohol fuels in aviation. Modified a company aircraft and piloted a transcontinental flight on ethanol.

Jack La Mothe and Lawrence Matt

Division of Aeronautics, Illinois Department of Transportation, Springfield, Illinois
Alcohol fuels in aviation. Modified an Illinois State aircraft and piloted the plane on a cross country flight--Springfield, IL, to Marianna, FL, and return.

George W. Thomas, Jr.

AGRI-FUEL Systems, Inc., Cleveland, Tennessee
Pioneer in the production of ethanol from animal waste.

Al Mavis

President, Alenco, Rochester, Illinois
Recognized expert and pioneer in the small to medium scale production of ethanol and the utilization of alcohol fuels.

Peter Widner

President, Agro Gas, Cresco, Iowa
Internationally-recognized expert and pioneer in anaerobic digesters--the production of methane gas from animal wastes.

R.L. Bibb Swain

President, EnerDyne Corporation, Manchester, Tennessee
Recognized expert and pioneer in the field of vapor recompression and low energy conversion of starch crops to ethanol.

Raymond Rissler

President, MGS, Inc., California, Missouri
Recognized expert and pioneer in the field of sawdust gasification. Also designs and builds small scale gasifiers using wood chips and blocks.

Bill Ayers

Vice President, Buck Rogers, Inc., Kansas City, Missouri
Manufactures and markets small and medium scale gasifiers representing the state-of-the-art technology. Company received the Governor's new product award for 1982 presented by the Kansas Engineering Society.

Ted Keehen

Vice President, Farmers Group Purchasing, Topeka, Kansas
Identifies state-of-the-art technology in farm energy systems; upgrades the engineering and subsidizes manufacturing where necessary; and markets these systems with needed performance guarantees.

Dr. Harry La Fontaine

Consultant, Miami, Florida

Recognized international expert on wood gasification.

Willis Wittmer

Distributor, Conklin Company, Minneapolis, Minnesota

Conklin manufactures and markets turn key, small scale (40,000 to 70,000 gallons a year) ethanol plants.

Dave Keenan

Wood Energy Manager, Morbark Industries, Inc., Winn, Michigan

Morbark is in the forefront in designing, manufacturing and marketing wood energy equipment and systems.

We appreciated the opportunity to participate in the conference and to be present during your congressional hearing. While we understand the importance of the process we observed, as well as the essential services provided by the testifying witnesses, we found no relief to the frustrations we face in finalizing technological advances, funding proof of concept demonstrations, locating needed capital to effectively enter the marketplace and gaining the level of government support necessary to systematically establish public confidence in emerging technologies.

With few important exceptions, these pioneers and innovators have received no help from the government: no funds; no technology transfer; little or no information; and no Federal research focused to resolve lingering problems. The important exceptions

are the tax credits that are essential to these emerging industries and vital to privately-funded research and development projects.

In spite of obstacles and handicaps they continue to encounter, these innovators push on for a set of reasons, most of which surfaced during your hearing:

- Continue to reduce dependence on imported oil. Although imports are down significantly, the U.S. still purchased over $65 billion of foreign oil in 1982.

- Promote community self-reliance and thereby reduce energy vulnerability (due to availability of locally-produced energy) in the event of a war or national emergency. A nation of self-reliant communities enjoys greatly enhanced national security as well as a more secure support base from which several complex international issues can be dealt with more objectively.

- Pursue technological advances to successful market entry because of the challenges involved, personal gratification and the opportunity for economic gain.

- Reduce environmental pollutants, specifically acid rain and atmospheric CO_2 build up, through lower temperature combustion of renewable biomass which, through the photosynthesis process, extracts carbon dioxide and nitrogen

(with some plants) from the atmosphere. In addition, biofuels generally avoid the introduction of polynuclear aromatics and other carcinogens affiliated with fossil-based fuels. Of course, biomass must be continuously replanted and properly cared for to be classified as renewable.

- o Promote community development through local production of energy which will create jobs and retain capital to benefit from the multiplier effect.

- o Open new markets for agriculture crops that will improve the economic well-being of farmers and rural communities. PIK is recognized as a stop-gap measure with detrimental impacts on the agriculture support sector.

- o Gain support for integrated farm systems that benefit from the economies of scale. These systems, if modern science and technologies are effectively applied, will abundantly produce food, feed, fiber, fuel, fertilizer and/or chemical feedstocks.

- o Through the application of modern science and technology, reduce the family farm's dependence on conditions over which rural communities have little or no control:
  - cost and availability of energy
  - cost and availability of fertilizers and pesticides
  - cost and availability of investment and operational capital
  - timely availability of needed markets.

- Take advantage of the time being provided by the current abundance of energy supplies to develop and put into place the energy systems of the future that are renewable, environmentally beneficial, and will create large numbers of meaningful jobs. Further, it is recognized that fossil petroleum resources are and will continue to be increasingly valuable. To the benefit of future generations, time should be used to develop substitutes to permit preservation of these vital resources rather than developing technologies to hasten their depletion.

In pursuit of these goals, there is general consensus that different government methods are needed in order to better apply public resource to problem resolution. It is generally believed that current methods commit excessive resources to maintaining bureaucratic systems and to support institutions or corporations that already have commanding positions in the energy and chemical areas. For example: "Motorola; Shell Oil Company; Arthur D. Little, Inc.; Boering Aerospace; and an industrial manufacturer's joint venture were among the firms benefiting from SERI (Solar Energy Research Institute) staff and subcontracted research." Attachment A. Current methods are simply not effective in allocating resources, at least in terms of rural development, to innovators who are at the cutting edge of their respective technologies. Those participating in the 4 E Conference are advancing technologies in:

- o Biomass planting, harvesting, chipping and chip handling.
- o Combustion and gasification of biomass.
- o Small scale ethanol production.
- o Production of methane and fertilizers from animal waste through anaerobic digestion.
- o Production of ethanol, methane and fertilizers from animal waste through fermentation and anaerobic digestion.
- o Greenhouse operations co-located with an ethanol plant to take advantage of waste CO_2 and heat.
- o Integrated farm systems applying several of these technologies.
- o Engine designs and conversions to accommodate biofuels.
- o Conversion of aircraft engines to combust alcohol fuels, flight testing of the aircraft and certification of the engines and the fuels.

The effective application of these technologies, in concert with others, will lead to the revitalization of rural America. Although the governments, Federal and State, are conducting research and development in these areas, the innovators and small business people only infrequently benefit from these public expenditures.

In hope of correcting these serious deficiencies, the following recommendations are submitted:

1. Support H.R. 1595, the "Solar Energy National Security and Employment (SENSE) Act of 1983." Attachment B. Additional recommendations on possible legislation are at Attachment C.

2. Take corrective action to ensure that the Internal Revenue Service recognizes biomass as a renewable energy resource.

3. Recognize that tax credits are highly effective mechanisms to spur research in innovative technologies in small business which have great difficulty in accessing other government R&D programs, that, by necessity, are more geared to "Grantsmanship" than to actual capabilities.

4. Take action to ensure the availability of responsive, technically and financially competent loan officers who will encourage the placement of loans involving proof of concept demonstrations. The same officers could assist in locating public funds or venture capital when the applicant needs such support and the demonstration justifies such involvement.

5. Consider pilot programs where a community or junior college, or area vocational school, would have rapid access to Federal or State funds to support promising innovations and/or proof of concept demonstrations. The availability of public funds would be contingent on a successful, local, technical and peer review to demonstrate worthiness, on the availability of local cost sharing funds, on a market development concept,

and on the availability of a manufacturer committed to produce the product, if it proves successful, for initial market entry. This program would be tied into the major R&D centers for assistance and would help identify more sophisticated R&D projects responsive to identified local needs.

6. Consider support for a pilot project at Chipola Junior College involving wood gasifiers and energy emergency preparedness. Western Florida is ideal for this project because of its dependence on imported energy, the availability of wood, and the responsiveness of the biomass program at the University of Florida and Dr. La Fontaine of Miami. In the event of a serious curtailment of liquid fuels caused by a war or natural disaster, farming and other essential services must continue--wood gasifiers, produced and installed under emergency conditions have proved successful. A four part program is suggested:

   - o A college level course for academic credit on the history, chemistry and technology of wood gasifiers.
   - o A vocational level course on the technology, production, installation, operation and maintenance of wood gasifiers.
   - o A community outreach program to explain the project.
   - o A controlled test, under stimulated conditions, to demonstrate the viability of wood gas (or other biofuels) to provide energy for farm and emergency equipment.

7. Consider support for the Illinois aviation program. Attachment D.

8. Consider support for a new heating and cooling system (the need for a new plant is firmly established) for Chipola Junior College based on conservation and a biomass energy system.

9. Consider support for a cooperative effort between Marianna Sunland, the Appalachia Correctional Institute, the Arthur Dozier School for Boys and the Florida State Hospital at Chattahoochee to make these institutions more energy and food self-reliant. The natural resources (land and water) and the people are available to pursue this goal which will reduce public expenditures, provide excellent work therapy and develop skills that will be very useful to the participants. Again, modern science and technology should be used to increase the efficiency of the operation and to enhance the value of the skills to be developed. Note: a survey of the dairy operation at the Appalachia Correctional Institute indicates that an anaerobic digester/alcohol plant/greenhouse operation is feasible.

There is a general conviction that the United States must now look to modern science and technology as we approach the 21st century. These existing and emerging assets can be applied to successfully revitalized rural America. But rural people must participate in this evolutionary process that will not only produce new products, but will also provide large numbers of jobs while having the potential to enhance the environment. Rural people themselves have the skills to merge new advances with the realities of nature and local conditions and to generate additional innovations and technologies pertinent to their communities. This testimony is submitted to assist in this important effort.

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